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The new water-works tunnels at Chicago are to be investigated by a board of expert engineers, unless arrangements now being made to that end fall through. On Jan. 30, J. Frank Aldrich, Commissioner of Public Works, wrote a letter to the Western Society of Engineers asking that a committee be appointed to examine and report upon the tunnels. The society, or many of its members, did not feel that such an investigation came within its province, but on motion of Mr. Octave Chanute the Board of Directors was asked to present to Mr. Aldrich the names of ten or more competent engineers of this country, whether members of the society or not. Recently, according to a Chicago paper, Mr. Isham Randolph, President of the Society, submitted to an investigating committee of the City Council the names of the following engineers as in every way competent to serve: L. L. Buck and A. Fteley, New York; E. H. Johnson, Alfred Noble, R. J. McClure and George C. Smith, Chicago; Gen. O. M. Poe and Willard S. Pope, Detroit; John Whitelaw, Cleveland; R. E. McMath, St. Louis. The Council Committee proposed to ask the Council for an appropriation to meet the expenses of the experts. At latest reports no further action had been taken, and none of the engineers named above had been asked to serve. The cause for the proposed investigation is said to be numerous statements, mainly in the daily papers, reflecting on the character of the work. The construction of the four-mile tunnel was begun late in 1887 (see Eng. News of July 5, 1890, for description and account of progress).

The lease of the Lehigh Valley R. R. and the Central R. R. of New Jersey to the Philadelphia & Reading R. R. Co. is announced. The terms of the lease are stated to be as follows: To the Lehigh Valley Co. the Reading guarantees 5% on its stock up to July 1 of this year, 6% for one year thereafter, and then 7% perpetually. The surplus profits over 7%, if there are any, are to be divided evenly between the two companies, and if it should come to pass that the earnings of the Lehigh Valley ever exceed 10% on the stock, all over 10% goes to the Reading Co. The Jersey Central Co. is guaranteed 7% on its stock, the surplus over the amount necessary to pay that guarantee to be divided evenly between the two companies. There is to be but one coal sales agent for the three companies. By this move the Reading adds 1,546 miles to its system, excluding the new line built during 1891, approximately, 150 miles, and secures lines which, with its own, control about 60% of the anthracite coal trade.

The greatest consolidation in the electrical business yet undertaken is now being negotiated between the Thomson-Houston and Edison electric companies. A number of prominent stockholders of both corporations have agreed on a basis for consolidation, and have issued an invitation to stockholders in favor of the proposition to deposit their securities with designated trustees. The committee having the gigantic deal in charge includes Messrs. J. Pierpont Morgan, D. O. Mills, H. McK. Twombly and Frederick L. Ames. The consolidated company is to be capitalized at $50,000,000, of which not more than 20% is to be preferred stock entitled to 7% cumulative dividends. The Edison general electric stock and the Thomson-Houston preferred stock is to be exchanged for the stock of the new company at par. The Thomson-Houston common stock is to be exchanged at 60 for the new shares at par.

Underground electric railways seem to be popular in London just now, as two new bills are before Parliament asking for power to build the following roads: The Waterloo & Baker St. Railway, to cost $6,250,000, and the Waterloo & City Railway, to run from Lambeth to the Mansion House, and estimated to cost $2,140,000. Both roads are to be operated by electricity.

The gage question for Russian railways appears to be rather more mixed than in India. According to the latest published Russian statistics on this head (to Jan. 1, 1888) the total length of railways was 26,964 km., of which 22,710 km. were single track. The Transcaspian railway, of 1,064 km., and the Finland railway of 1,547 km. are not included in the summary. The State only owns 4,684 km. of single track and 114 km. of double track. As regards gage the Russian lines are divided as follows:

Gage 1.523 m. (5 ft.),	total length	25,933 km.
" 0.913 m. (3 ft.),	" "	32 km.
" 1.067 m. (3½ ft.),	" "	436 km.
" 1.435 m. (4 ft. 8½ in.),	total length	520 km.

The total capitalization is placed at $70,160 per mile for State lines and at $122,661 per mile for private lines. The staff of officials and workmen employed numbers 218,154 persons, costing $13,350,947 per annum. In connection with the subject of Russian capitalization it is mentioned that the average primary expenses of railways in various countries is as follows:

Country.	Francs per km.	Dollars per mile.
Russia	380,250	$122,661
France	312,632	100,850
Germany	314,882	101,560
Austria-Hungary	478,760	125,406
England	688,850	222,210
United States	169,347	53,016

The semicircular roof shield in use at the York Road tunnel of the Baltimore Belt R. R., which was illustrated and described in our issue of Jan. 9, has settled at the crown so much that work with it has stopped and it is now being dug out. As stated in our description, the removal of the centering on which the shield was built caused it to spread at the feet, rise at the haunches and settle several inches at the crown. Efforts to force the shield back to a semicircular form were fruitless; but as no further settlement was noticed the shield was driven ahead some distance. Recently, however, careful measurements showed that the crown of the shield had settled a foot and a half or more, and as this brings the tunnel roof too low to comply with the contract requirements, work with the shield has been suspended. A new shaft is now being sunk directly over the shield, large enough to entirely uncover it and remove it if necessary. It is possible, however, that it may be decided to rebuild and strengthen the shield and give it a further trial.

The use of the shield in driving this tunnel was undertaken to test the shield, which is an invention of Major Richard Randolph, the Chief Engineer, and not because it was supposed to be the cheapest or best method of driving this especial tunnel. The depth of the tunnel is so small that it could have been built more cheaply in open cut than by any other method, and this made it a suitable place for experiment, as in case of trouble the shield could be easily dug out.

The most serious railway accident of the week was a collision on the Chicago & Alton R. R., at Larabee, Kan., Feb. 7. A fast passenger train was turned onto a side track by an open switch and collided with a stock train. There were 3 trainmen killed and 2 injured, but none of the passengers were hurt. Both engines and two of the stock cars were wrecked. A long freight train on the Baltimore & Ohio R. R. ran away on the 17 mile grade near Bloomington, W. Va., and at a curve at the stone bridge over the Potomac River and the West Virginia Central & Pittsburg R. R. The entire train, with the exception of the engine and one car, left the track and went off the bridge, the wreckage blocking the railway tracks and the river. One man was killed.

A cable car on the Montague St. line, Brooklyn, N. Y. ran away Feb. 9 on the steep grade to the Wall St. ferry. The front of the car was smashed against the bumper in front of the ferry house and the gripman was injured. Some of the passengers were cut and bruised. The gripman had released the cable near the top of the grade to avoid running into a carriage, and was unable to pick it up again, while the brakes also refused to act.

A locomotive boiler explosion occurred Feb. 2 on the Chicago & Alton R. R. near Joliet, Ill. The engine was pulling a heavy freight train up a grade, being assisted by a pusher engine, when the boiler exploded, killing two men and injuring another.

A new East River bridge bill is before the New York Legislature. This is the Manhattan & Long Island Bridge Co., and two bridges are proposed, one across the East River at Blackwell's Island and the other crossing at Ward's Island. The capital is $15,000,000, and the chief incorporators are Zenas King and two of his sons, who control the King Bridge Co., of Cleveland, O.; Daniel P. Ellis, a Cleveland banker; Chas. A. Otis, of the Ohio Steel Works; Daniel Magone, late Collector of the Port of New York; Charles F. Stowell, of Albany, N. Y., etc.

The Lake Erie-Atlantic Ocean ship canal project is now before the House Committee of Congress on Railways. Capt. Kingman, U. S. Engineers, indorsed the following route: Down Niagara River from Lake Erie to a large island above the falls, then a canal to Lake Oswego; thence through Ontario to the city of Oswego; from Oswego to Lake Oneida, 34 miles through a canalized river; then through Lake Oneida, 23 miles from Oneida down the Mohawk River, canalized, to Albany and the Hudson River, 129 miles distant. Capt. Kingman thinks this waterway can be made for $110,000,000. The Hudson, from Albany east, has only 11 ft. of water now, and it would cost, in addition, about $6,000,000 to dredge a channel 21 ft. deep. The committee was evidently much interested in the project, but whether they will recommend an appropriation for the survey, to cost $10,000 to $100,000, is quite another matter.

A Niagara River railway tunnel bill is before the New York Legislature. The tunnel would pass under the Niagara River from the foot of Genesee St., in Buffalo, to a point on the opposite Canadian shore. The capital is $1,500,000.

The erection of the Reading terminal trainshed, at Market St., Philadelphia, is commenced. The arched roof will have a span of 265 ft. 10¾ ins., and it will be 90 ft. high from the floor of the station and 120 ft. from the street level. The train shed will be 553 ft. long, and the station proper 110 ft. more, or 663 ft. in total length. The shed will contain 13 tracks converging into 9 at the north end.

An electro-pneumatic signal plant has been put in at the St. Clair tunnel by the Union Switch & Signal Co. The plant is of a simple character, consisting of interlocked signals and derailing switches at the end of each approach. Before a train can pass through the tunnel the operator at the farther end must set a danger signal and open the derailing switches against trains going in the opposite direction. The operator at the end where the train is entering can then give a clear signal. The train sets all signals automatically to danger as it enters the single track approach, and they are locked in that position until the train passes out of the tunnel at the other end. Derailing points are also provided on each approach to prevent the rear portion of a train from running back into the tunnel in case of a break-in-two. The approaches have a grade of 2% and are each about a half-mile in length.

The suppression of grade crossings on the many railways passing through Worcester, Mass., is made the subject of a report by a special commission of engineers, viz.: City Engineer C. A. Allen, Mr. A. A. Locke, of North Adams, and Mr. J. W. Ellis, of Woonsocket, R. I. After considering five plans submitted the commission recommends, as best and most economical, the raising of the tracks instead of depressing them. The estimated cost is $1,907,050 for the crossings in the business portion of the city, and $187,000 in the outlying sections, a total of $2,094,050. There are 59 railway crossings in the city, 39 being at grade, 13 streets pass under the tracks and 7 pass over.

The utilization of water power by electric transmission is thought of in Sweden, says the "Schweizerische Bauzeitung." The water power of the Trollhaetta Falls, in the vicinity of Gothenburg, is to be utilized for the purpose of generating the 7,000 HP. required in that city. The cost of one HP. gained by electric transmission, according to calculations, will be $20, approximately, which does not appear to leave a very large margin for profit.

The South Russia iron and steel industry, based upon the discovery in 1873 of an 18 ft. vein of rich and pure ore, containing 67 to 69% of pure iron, without any (?) detrimental ingredients, has assumed large proportions. The yearly product now amounts to 500,000 tons, the Société Cockerill and two Russian companies being the largest operators. Fuel is obtained from an adjacent coal district in the Don Cossack and Donetz country, known since the time of Peter the Great.

The new Bahama cable to the United States is 230 miles long and cost $150,000, or about $650 per mile. It was laid rapidly and without any trouble.

The first Bessemer steel made in the Lake Superior district was blown on Jan. 27 by the West Superior Iron & Steel Co., at West Superior, Wis. The company will manufacture plates and structural shapes. Mr. W. F. Mattes is General Manager. The plant was built by the Pittsburg Iron & Steel Engineering Co., a corporation in which the well-known firms of Riter & Conley and Mackintosh, Hemphill & Co. are united.

THE TRANSANDINE RAILWAY.

In Engineering News, Oct. 25, 1890, were given plans and a general description of this railway, which is to form the connecting link in the east and west transcontinental railway between Buenos Ayres in the Argentine Republic and Valparaiso in Chile, a total distance of 850 miles. The Transandine Railway will be 150 miles long, extending from Mendoja in the Argentine Republic to Santa Rosa in Chili. The Argentine section, owned by the Buenos Ayres & Valparaiso Transandine Ry. Co., is 110 miles long, and the Chilean section, owned by the Transandine Ry. Co., is 40 miles long. These companies will probably be consolidated after the line is completed. The general situation of the line, and its relation to existing lines and the projected intercontinental railways, are shown on a map in another column, accompanying an article on the intercontinental railway. We have received from the contractors, Messrs. J. E. & M. Clark & Co., of London, a book of handsome photographic views along the line and plans showing the progress up to Jan. 1, 1892, some of which we reproduce.

Fig. 1. Map of Transandine Railway.

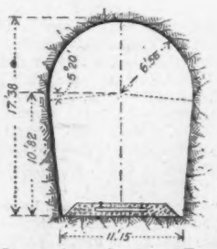


Fig. 3. Cross Section of Tunnels; Transandine Railway.

The summit is 10,500 ft. above sea level, while that of the Oroya Railway in Peru is 15,000 ft. At the principal places where snow and avalanches are to be feared the line is in galleries cut through the solid rock along the slopes of the mountains. The maximum grade for adhesions section is 2½%, but the maximum grade for rack rail sections is 8%, on which the Abt rack rail system is used. Work on the Argentine section was commenced Jan. 1, 1887, and on June 6, 1891, the line was completed and ready for traffic to Rio Blanco, kilo. 120, while the earthworks were in progress to Punta de las Vacas, kilo. 142. Some work has also been done in boring the summit tunnels, for which electric air compressing plants were used, but this work has been suspended for the present. The rails are now laid to kilo. 150. On the Chilean section work was commenced April 5, 1889, and track has been laid to kilo. 27. All the materials are on the ground, and it is said that the works are so far advanced that if pushed forward with as much energy as they were commenced, the whole section could be completed and open for traffic within six months. When the revolution occurred in Chile early in 1891, closely following the financial crisis in the Argentine, the work on both sections was being pushed vigorously. The plan, Fig. 1, shows the present condition of the work. The tracklaying on the Argentine section progressed as follows:

Dec. 2, 1889	35 kilos.	21.70 miles.
Dec. 9, 1890	39 "	24.18 "
Dec. 9, 1891	46 "	28.52 "
Total	120 "	70.40 "

For about 15 miles from Mendoza the works were very easy, but thence to the 55th mile great difficulties presented themselves, and much delay was caused by the impossibility of getting material ahead of the rails, so that bridges could not be built in advance of the tracklaying. Leaving Mendoza at an elevation of 2,376 ft. above the sea, the line passes through vineyards and cultivated country for 13 miles to the first station, Blanco Encalada, two miles beyond which is a bridge of six deck lattice spans of 66 ft. across the Mendoza River. At 19 miles from Mendoza the railway enters the gorge formed by this river and commences the ascent of the Andes, the heavy work beginning here. Entering the gorge by a series of deep cuts and a short tunnel, the line again crosses the river by a bridge of 148 ft. span, and from there to the 30th mile it crosses the river five times by bridges of 148 to 246 ft. span. One of these bridges, the Caleton bridge, at kilo. 36.4 from Mendoza, is shown in Fig. 3. After passing the Paramillos plain a tunnel is entered, and at 34 miles there is another bridge of 246 ft. span, between which and the Uspallata station are several tunnels and three large bridges, besides smaller bridges crossing streams which flow into the Mendoza. The numerous tunnels and deep cuts are made necessary by the spurs of the mountains. There was no road over which the heavy bridge girders could be carted. From Uspallata to Punta de las Vacas the works were less difficult, and between Rio Blanco and the summit tunnels is the first rack rail section.

On the Argentine side there are four tunnels close to the summit, having a total length of 13,743 ft., and and during the eight months preceding the stoppage of work last autumn the headings had been driven 5,628 ft., leaving 8,115 ft. of heading to be driven. This is considered satisfactory progress, half of the time being in winter, when less work can be done. On the Chilean side there will be five tunnels, aggregating 36,630 ft. in length, or 6.94 miles, of which 1,846 ft. of heading were driven in seven months by hand labor alone. These tunnels are almost continuous, as shown by the plan of the summit section, Fig. 2, and in one of these, the Portillo tunnel, the necessary grade is obtained by a tunnel spiral, as shown, the curves of which are 656 ft. radius. The progress plan, Fig. 2, shows the headings completed up to Jan. 1, 1892. Beginning about the middle of the Cumbre tunnel, is the steep descent to Juncal, with an almost continuous grade of 8%, and on this section the Abt rack rail system will be used for about 8 miles. Much of the tunneling is in sidehill ground, so that the drilling can be started from a number of working faces, which will considerably facilitate their rapid construction. They will all be in hard rock, requiring no lining; they will afford complete protection from snow, and as the grades are steep

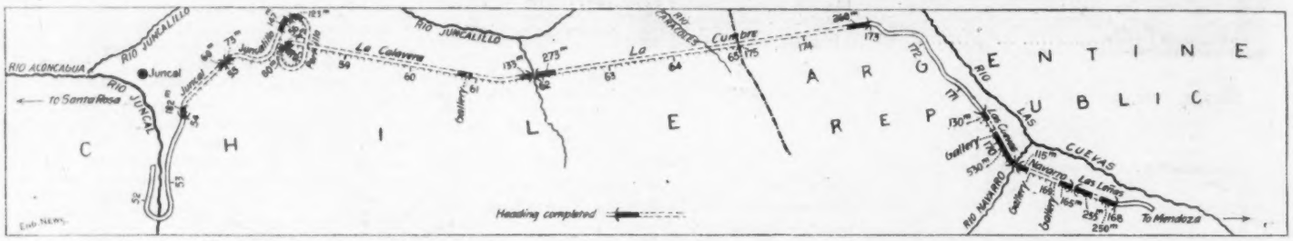


FIG. 2. PLAN SHOWING PROGRESS ON SUMMIT SECTION UP TO JAN 1, 1892; TRANSANDINE RAILWAY.

FIG 4. CALETON BRIDGE, 147.6 FT. SPAN; ARGENTINE REPUBLIC, TRANSANDINE RAILWAY.

no difficulty in ventilation is expected. Of the 40 miles on the Chilean side there are 23 miles completed, and of the remaining 17 miles, 7 miles will be in tunnel. The lengths of the five tunnels on the summit section are as follows:

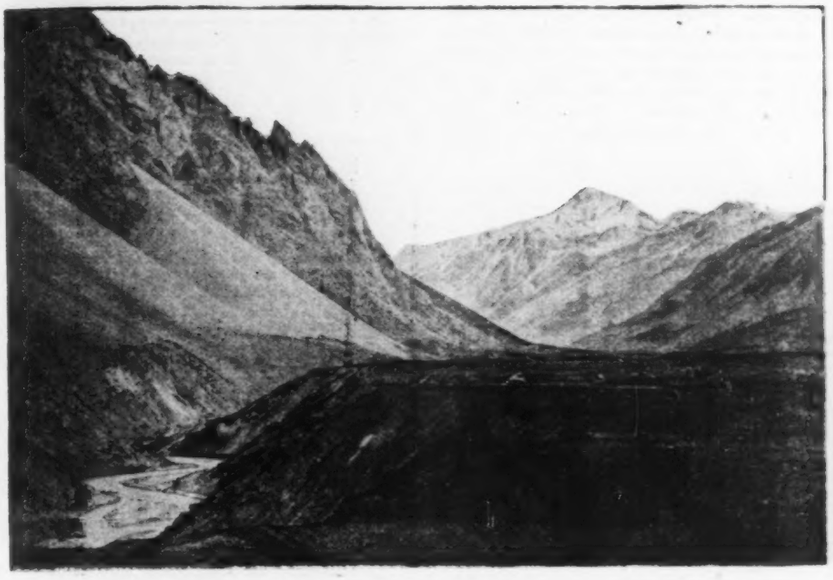


FIG. 5. VALLEY OF THE INCA, END OF TRACK ON ARGENTINE SECTION; TRANSANDINE RAILWAY.

La Cumbre tunnel	(6,269 ft. on the Arg. section)	16,613 2 ft.
La Calavera	"	12,300.0 "
Portillo	"	6,182.8 "
Juncalillo	"	4,182.0 "
Juncal	"	3,621.0 "
Total		42,899.0 "

Fig. 3 shows the tunnel cross-section, which has an area of 199.25 sq. ft. Owing to the lack of fuel in the neighborhood, and the cost of obtaining it, water power was utilized for driving the electric generating plant to work the air compressors for the drills, the water being carried from tanks or reservoirs supplied by rivers to the plant through steel pipes 20 ins. diameter. There are three of these power stations near the Navarro tunnel on the Argentine side, and at Juncal and Juncalillo on the Chilean side. The former has 4 Girard turbines of 80 HP. at 700 revs. per minute, each driving 2 dynamos of 40 HP. From these dynamos the power is transmitted by cables to the compressor plant about a mile distant, consisting of 4 motors of 30 HP. driving 4 compressors, which force the air into large steel reservoirs, whence it is conveyed to the drills through wrought-iron pipes 4½ ins. diameter. The two other power stations have each 6 turbines of 80 HP. driving 6 dynamos of 80 HP. from which the power is transmitted to 6 compressors. The drills are of the Ferroux type, 6 of them being mounted on a car running on a track of 2 ft. gage. Ingersoll drills have also been used. The machinery was manufactured in Switzerland, the turbines being furnished by Escher, Wyss & Co., of Zurich; the dynamos and motors by the Oerlikon Co., of Zurich; and the compressors by Burckhardt & Co., of Basle.

Although the full benefit of the railway will not be felt until the line is completed, the existing sections are of great importance, as the journey between the two ends, at Punta de las Vacas and Guardia Vieja, can be accomplished on mules in 9 hours, and the journey from Mendoza to Santa Rosa thus made in 18 hours instead of the 5 days formerly spent in riding through the very difficult passes. It is also intended to improve the road over the pass so that carriages can be used. As to the traffic of this railway, it is expected to prove remunerative, as the line will serve a considerable area of agricultural and productive country, and will secure the through passenger interoceanic traffic. There has been a considerable traffic over the pass for some years, and the railway facilities will tend to increase it, especially as by railway the traffic can be carried on throughout the year, while by the road it is only possible to get through during the summer. The views in the book referred to show the rocky and barren nature of the mountain division on the Argentine section. There are but few traces of vegetation, and the rocks are bare and rugged, with great smooth slopes of debris or talus. Fig. 4 shows the beginning of the mountain work on the Argentine section, 22½ miles from Mendoza; Fig. 5 shows the Valley of the Inca, near Punta de las Vacas, the present end of the line on that section, 90 miles from Mendoza; and Fig. 6 shows a somewhat less forbidding character of country on the Chilean section at Los Quillayes, near the end of the completed work of that section, 130 miles from Mendoza and 20 miles from Santa Rosa.

RACE TRACKS.

At the meeting of the Engineering Association of the South, held at Nashville, Tenn., Jan. 14, Mr. W. G. Kirkpatrick presented a paper on "The Engineering Features of the Cumberland Race Track," which is a regulation track recently built in Nashville under the direction of the writer as engineer. The paper gave a full comparison of the relative advantages and disadvantages of the "kite shaped track" and the "regulation track," the latter of which was finally adopted. The principal advantages of a "kite-shaped track," in which each tangent and the arc are respectively one-third of a mile long, over the "regulation track," in which each tangent and each arc are one-fourth of a mile long, are: (1) The "kite-shaped track" has 150° less total curvature in its length, so that one-third of the track is on curve two thirds being on tangent, while in the "regulation track" half is on curve and half on tangent (2) the curvature in the "kite-shaped track" is described with a radius of 481 ft. instead of 420 ft. as in the "regulation track"; (3) excess distance above a mile passed over by a horse at any given distance from the "distance line" on the "kite-shaped track" is only seven-twelfths of the corresponding excess on the "regulation track," thus a line 10 ft. outside the standard mile line or "distance line" exceeds a mile by 37 ft. on a "kite-shaped track" and 63 ft. on a "regulation track."

In spite of these advantages the difficulty of fitting the "kite shaped track" to the topography of the ground without excessive earthwork led to the adoption of the "regulation track." As it was, cuts of 21 ft. and fills of 19 ft. were required. The width of track varies from 65 ft. on the scoring stretch and home stretch to 40 ft. on the other portion of the track. The maximum grade was 0.33%, with a lateral slope toward the inside of track, of 1 in 90 on tangents and 1 in 12 on curves, the superelevation of curve being acquired by raising the outside and not by depressing the inside. One-half was attained on the tangents, and one-half on the curves, the slope running 200 ft. each way from tangent point for 40 ft. widths and corresponding distances where the width was greater. After bringing the track up to sub-grade, the surface was finished by 12 in. of dry sod or turf set on edge covered with 3 ins. of black loam and after being finished by rolling and sprinkling the surface was planed off by a track machine, and swept with a cedar brush. At two points the track crosses Brown's Creek, a stream about 35 ft. in width, and is carried over at each place by bridging of two spans of 17½ ft. each, com-

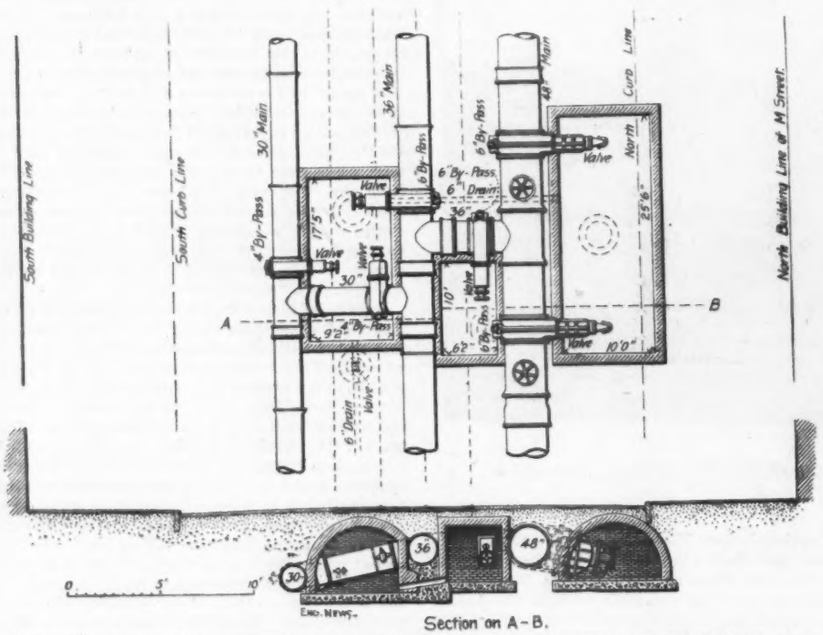
FIG. 6. LOS QUILLAYES, END OF CHILEAN SECTION; TRANSANDINE RAILWAY.

posed of steel I-beams with heavy lateral and transverse bracing. The I-beams carry steel railway rails, on which is a floor of cedar, carrying 2 ft. of earth, the object being to make the portion of the track on the bridges as rigid and noiseless as the other portion of the track. Particulars of the laying out and construction of regulation and kite shaped tracks have been given in our issues of July 5 and Oct. 11, 1890.

A 48 IN. WATER MAIN AT WASHINGTON, D. C.

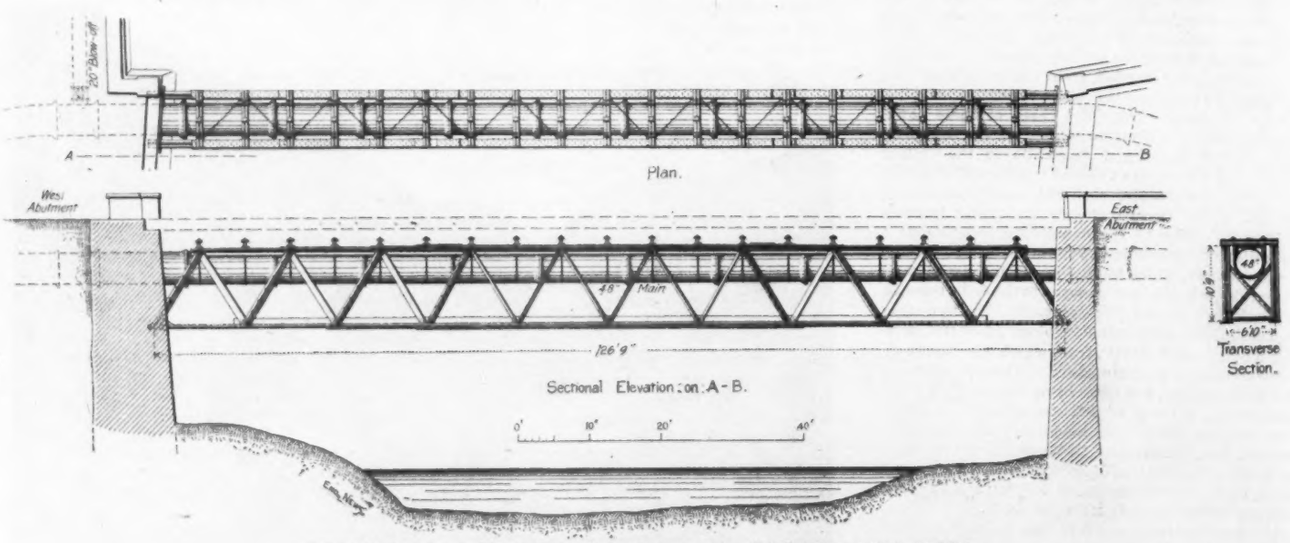
The accompanying illustrations are taken from the last Annual Report of the Washington (D. C.) Aqueduct Tunnel, and was recommended by Expert Engineers Jos. M. Wilson, Henry Flad and Frederic Graff. (See Eng. News, May 11, 1889, for abstract of Experts' Report, and Feb. 16, 1884, and Feb. 14, 1885, for descriptions of tunnel.)

The details of the pipe connections are plainly shown in the illustration and need no comment or explanation. The same may be said of the bridge, the plan, longitudinal elevation, section and cross-section showing the construction plainly. The report from which the illustrations are taken contains no information regarding the above further than is shown by the illustrations. Attetion may be called to the nearness of the gate-vaults to the surface of the street.



Section on A-B.

PLAN OF CONNECTION BETWEEN 48-IN., 36-IN. AND 30-IN. WATER MAINS, WASHINGTON, D. C.



WROUGHT IRON RIVETED BRIDGE CARRYING 48-IN. MAIN OVER ROCK CREEK.

Aqueduct, Geo. H. Elliott, Lieut.-Col. of Engineers, U. S. A., officer in charge. The illustrations show connections between 48, 36 and 30-in. mains in M St., between Twenty-ninth and Thirtieth Sts., and also a wrought iron riveted girder bridge carrying a 48-in. main over Rock Creek. The pipe connections and bridge are on the line of the 48-in. cast-iron main recently laid from the Georgetown distributing reservoir to connect with a 48-in. main from a new reservoir at Fourth and R Sts., and with some of the other large supply mains in the distributing system. This pipe line is a substitute for the abandoned Washing-

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Liability of Company for Discoverable Defects.

A defect in a car which could be discovered by inspection is one which can only exist by or through the negligence of the company, and, therefore, when an employee is injured by reason of a defect which he can show could have been discovered had the car been properly inspected, he is entitled to recover damages. (Cowan v. Chicago, M. & St. P. Ry. Co., Supr. C. Wis., 50 N. W. Rep., 180.)

Liability for Dangerous Condition of Yard.

A railway company is liable to an employee who, in the discharge of his duties as a switchman, without negligence on his part, catches his foot in a tie which has been split and sprung so that it projects above the surface, as it is the duty of the company to keep its yards free from obstructions which will endanger the safety of its employees. (P. Co v. Brush, Supr. C. Ind., 28 N. E. Rep., 615.)

Damage for Change of Street Grade.

A city having changed the established grade of a street where it crossed another street, and damages having been assessed and paid, in accordance with the charter, for the injury resulting therefrom to a lot fronting on the latter street, the city is held not to be again liable to the owner of such lot by reason of the fact that such a change of grade had cut off all access thereto. (Keil v. City of St. Paul, Supr. C. Minn., 50 N. W. Rep., 89).

Care of Tracks by Company—Duty of Engineer—Mortuary Tables.

Where it is alleged, in a suit for injuries causing the death of a locomotive engineer, that the engine was derailed by striking some ice that had been washed on the track by the overflowing of a creek, the testimony of a witness who visited the scene of the wreck shortly after the accident, as to whether the ice appeared to have been struck by the engine, is not objectionable, as calling for the opinion of the witness on a material question. Where a rule of the company requires engineers to run very cautiously during and immediately after a heavy rainstorm, a finding by the jury that decedent was running without reasonable precaution, immediately after a heavy rain-storm, shows that decedent complied with the rule, as the finding will be taken to mean that he was using reasonable precaution under the unusual circumstances. Where the evidence shows that the track at the place of the accident was liable to be overflowed in heavy storms; that a heavy rain fell the night of the accident; that the ties at that point were unsound; that the ice did float onto the track; that the engineer had been warned to be careful at other places, but not at this place specially; that he was running with care, but that on account of fog he could not see the ice till too late; that the section foreman had been along a few hours before and saw that the water was rising, and that the derailment was partly due to the ice and partly to the bad condition of the track, which let the rails spread—a verdict for damages for the wrongful death of the engineer is justified. The Northampton and American life tables contained in volume 3, Johnson's New Universal Encyclopedia, are admissible in evidence, the work being standard and well known.—(Seagel v. Chicago M. & St. P. Ry. Co., Supr. Ct., Ia., 49 N. W. Rep., 991).

Liability for Unguarded Turntable.

Where a railway company constructs a turntable near a public highway, and fails to inclose it or guard or protect it in any manner, or even keep it locked, it is liable in damages for injuries sustained by children who play upon it. (Barrett v. So. Pac. Ry. Co., Supr. Ct. Cal., 27 Pac. Rep., 668.)

Injury of Car Repairer.

A car repairer was injured while at work under a car. It was within his discretion whether a car should be repaired on the tracks or in the shops, and when he elected to make the repairs on the track he did so with full knowledge of the dangers of that situation, and has no right of recovery against the company for the results of his own act. (Latremoville v. B. & R. Ry. Co., Supr. Ct. Vt., 22 At. Rep., 636.)

Knowledge of Coupling Defects.

One who accepts employment from a railway company as a switchman in its yard assumes the risk of injuries resulting to him from a visible defect in the locomotive on which he was to work, consisting of a drawhead so short as to leave too small space between the locomotive and any car to be coupled to it for the switchman to work with safety. When one of the rules of the company, which formed a part of the switchman's contract of employment, required him to inspect and take notice of the style of drawheads, etc., used in coupling engines and cars, and he alone directed the movements of the engine toward the car to be coupled to it, an injury resulting to him from their sudden coming together must be due to contributory negligence which will defeat his recovery.—Brooks v. Northern Pac. Ry. Co., United States Cir. Ct., Washington, 47 Fed. Rep., 687.

WORLD'S COLUMBIAN EXPOSITION.

[With inset.]

In our two previous articles (Eng. News, Jan. 16 and 30) on the World's Columbian Exposition, we have given descriptions and plans of previous international exhibitions and of the general character of the Columbian exhibition. In the present article we describe the style, appearance and arrangement of the several main buildings, illustrations of which are given on the inset sheet. In future articles we shall go somewhat fully into the more important construction details. The general appearance of the buildings and their grouping will be handsome and effective and will be rendered still more effective by the surrounding terraces, turf slopes and beds of flowers. The arrangement of the buildings was shown on the plan on page 51 in issue of Jan. 16, and is also shown by the bird's-eye view on the inset. The greater part of the exterior work and decoration of the buildings, as well as much of the interior decorative work, is of "staff," a material which consists of a cement plaster with jute fiber, the manufacture and application of which were described in the article in our issue of Jan. 16. In regard to the construction of the main buildings the idea has been kept in view of having the materials of as much value as possible after the exhibition is closed and the buildings have been torn down. Most of the buildings will have a yellow tone of color, with some exceptions, as noted in the descriptions, and the decorative work of the entrances, windows and architectural details will be very elaborate.

Administration Building.

This building will be in the center of the large open plaza near the middle of the group of main buildings. It will be one of the handsomest buildings on the grounds, and its great gilded aluminum dome will be a conspicuous features of the exposition. The building will cover a space of about 200 by 280 ft., or an area of 1.6 acres, its general plan consisting of four pavilions 84 ft. square at the corners of a central and higher structure surmounted by a dome 120 ft. diameter and 260 ft. high above the ground. The general design is in the style of the French renaissance, with the first story in the Doric and the second in the Ionic order. Mr. R. M. Hunt, of New York, President of the American Institute of Architects, is the architect, and the cost is estimated at $450,000. Each façade has a recess 82 ft. wide between the corner pavilions, with an arched entrance 50 ft. wide and 50 ft. high. The lower story is 65 ft. high, the second story is 65 ft. high and 175 ft. square. Above this is the octagonal base of the dome, 40 ft. high, and the dome itself, the top of which has an open skylight and the exterior of which will be gilded and decorated in bas-relief. Wide halls lead from the four main entrances to the rotunda, and there will be broad stairways and fast elevators giving access to the offices on the different floors. The pavilions have four floors. This building will contain the offices of the management and the national commission, police and fire departments, bank and post-office, bureau of information, committee rooms, etc.

Agricultural Building.

This is located at the south end of the park, near the lake front. It is a one-story building, in the classic style, 800 by 500 ft., covering an area of 9.2 acres and costing $540,000. The architects are McKim, Mead & White, of New York. It has a pavilion 64 by 48 ft. at each corner and a large central pavilion 144 ft. square, in which is the rotunda, 100 ft. in diameter, surmounted by a glass dome 130 ft. high. The corner pavilions are surmounted by domes 96 ft. high and are connected with the central pavilion by curtains, forming a continuous arcade around the top of the building. The grand entrance is on the north side and has Corinthian columns 5 ft. diameter and 40 ft. high. South of the building is an annex devoted chiefly to the agricultural and live stock interests. This will have on the first floor an information bureau, committee and waiting rooms, etc., while on the second floor will be an assembly hall with seating capacity for 1,500 persons, which will be used for lectures and meetings on various subjects connected with agriculture and stock.

Dairy Building.

This is located near the lake, at the southeastern part of the park, in the rear of the Agricultural Building. It is a plain but neat looking building with two stories, 95 by 200 ft., with an area of 0.5 acre. It was designed by Mr. C. B. Atwood, Chief Designer of the Construction Department, and cost $30,000. On the first floor are the office headquarters, an open space for exhibits and a room 25 by 100 ft., in which a model dairy will be conducted. This room is open to the roof; on two sides of this room are amphitheater seats accommodating 400 persons, and on three sides are galleries at the level of the second floor. Under the seats are refrigerators and cold storage rooms. On the second floor is a café, opening onto an enclosed veranda overlooking the lake.

Electrical Building.

This is one of the buildings of the main group enclosing the central plaza. It is 345 by 700 ft., covering an area of 5¼ acres, and cost $375,000. The architects are Van Brunt & Howe, of Kansas City, Mo. It is a two story building in the style of the Italian renaissance, with a nave and transept, each 115 ft. wide and 114 ft. high, having pitched roofs supported by steel trusses. These roofs have clear-story windows and skylights at the foot of the pitch. The rest of the building has a flat roof, averaging 62 ft. in height, and provided with skylights. The south pavilion has a deeply recessed archway 78 ft. diameter and 103 ft. high, forming the main entrance, in which a statue of Franklin will be placed and which will be a special feature in electrical illumination. The north pavilion is situated betweeen two semicircular projections of the building and is flanked by two towers 195 ft. high. The pavilions at the middle of the east and west sides are composed of two towers 168 ft. high, fronted by a portico of Corinthian columns. At each of the four corners is a pavilion surmounted by a light open spire or tower 169 ft. high, and midway between the corner pavilions and the central pavilions on the east and west sides is a subordinate pavilion having an open lantern covered by a low dome. There will be large entrances in each of the four main pavilions. Along the exterior walls are Corinthian pilasters 3 ft. 6 ins. wide and 42 ft. high, supporting a full entablature and resting upon a base 8 ft. 6 ins. high. The height of the walls from the ground is 68 ft. 6 ins. The second story is composed of a series of galleries connected by two bridges across the nave, and approached by four stairways from the main floor. The area of the galleries is 2.7 acres. The building will be decorated with appropriate designs, and the exterior arrangement and decorative details have been especially planned with a view to effective electric illumination at night.

Fine Arts Building.

This is located at the upper end of the group of main buildings, the main front being to the south and facing the lagoon, from which it is separated by terraces, with a broad flight of steps leading from the main portal to a boat landing. The building is in the Ionic style, and was designed in the Construction Department, under the the direction of Mr. D. H. Burnham, Chief of Construction, the details being planned by the Chief Designer, Mr. C. B. Atwood. The general outline was prepared by the late consulting architect, Mr. George W. Root. The cost is estimated at $500,000. It is of fireproof construction, the main walls being of brick, faced with staff covering and decoration, and the roof, floor, gallery and skylight framings are of iron. It is 500 by 320 ft., covering an area of 3.7 acres, and is divided by a nave and transept each 100 ft. wide and 70 ft. high. At the intersection is a dome 60 ft. diameter, the top of which is 125 ft. from the ground and is surmounted by a colossal statue of the Winged Victory. The main building is entered by four portals, ornamented with architectural sculpture and approached by broad flights of steps. The walls of the loggia of the colonnades will be decorated with mural paintings, illustrating the history and progress of the arts, while the frieze of the exterior walls and the pediments of the principal entrances will be ornamented with sculpture and portraits in bas-relief of the masters of ancient art. Around the entire buildings are galleries 40 ft. wide, forming a continuous promenade, and between the promenade and the nave and transept are the smaller rooms for separate collections. On each side are galleries 20 ft. wide and 24 ft. above the floor. The corners at the crossing of the nave and transept are arranged as small picture galleries. At each end of the main building and connected with it by handsome corridors are annexes having an aggregate area of 1.1 acres. The north front faces a wide lawn and the group of state buildings, and the grounds in the neighborhood of the building will be ornamented with statuary, etc. The building will be colored a light yellow, and the dome will be covered with turquoise blue tiles.

Fisheries Building.

This building is located at the north end of the main group, and comprises a large central structure 363 by 163 ft., with two octagonal buildings 135 ft. diameter connected with it by arcades. The building and annexes cover 2.2 acres and cost $200,000. Mr. Henry Ives Cobb, of Chicago, is the architect. The style of construction is Spanish Romanesque, with roof of Spanish tiles, and fish and other sea forms are largely used in capitals, brackets, cornices and other architectural details. In the main building will be the general exhibits, while one of the octagonal buildings will contain the angling exhibit and the other the aquaria. In the center of the latter is a rotunda 60 ft. in diameter with a basin or pool 26 ft. wide, stocked with gold and other ornamental fish, and having in the middle a tall mass of rock work, with fountains, aquatic plants, etc. At the sides of this annex are ten large tanks of 7,000 to 27,000 gallons capacity, and in the corridor or arcade, which is 15 ft. wide, are a number of smaller tanks of 750 to 1,500 gallons capacity. The glass fronts of the aquaria aggregate about 575 ft. in length and 3,000 sq. ft. of surface. The total water capacity of the aquaria is 18,725 cu. ft., or 140,000 gallons. Of this amount, 40,000 gallons are devoted to the marine exhibit, and in the entire salt water circulation, including reservoirs, there are about 80,000 gallons. The pumps are in duplicate, and have each a capacity of 3,000 gallons per hour. The supply of sea water will be secured by evaporating the necessary quantity at the U. S. Fish Commission Station, Woods Holl, Mass., to about one-fifth its bulk, so as to reduce the labor and cost of transportation. The fresh water required to restore it to its proper density will be taken from Lake Michigan. In transporting the marine fishes from the coast to Chicago about 3,000 gallons of pure sea water will be added to the supply each trip. The coloring of the building will be in red and buff, with a marine blue for the roofs.

Forestry Building.

This building is 200 by 500 ft., with an area of 2.3 acres, and cost $100,000. It was designed by Mr. C. B. Atwood, Chief Designer of the Construction Department, and is of a rustic order. It is located on the lake front, at the southeastern part of the grounds. On all four sides is a veranda, the roof of which is supported by a colonnade composed of tree trunks 25 ft. long, left in the natural state with the bark on. These trunks are contributed by the different states and territories and some by foreign countries, each furnishing specimens of its most characteristic trees. To each trunk will be attached a descriptive label. The sides of the building are of slabs with the bark removed, and the roof will be thatched with tan and other barks. The main entrance will be finished in different kinds of wood and woodwork. The forestry exhibits are expected to be very complete, and among those of interest to engineers and railway men will be specimens of various timbers, railway ties, and details of the U. S. Government tests of strength of timber. There will also be a special exhibit of metal railway ties and models of such ties, prepared by Mr. B. E. Fernow, Chief of the Forestry Division of the U. S. Department of Agriculture, in connection with the report on metal ties made to the Department by Mr. E. E. Russell Tratman (Bulletin No. 4, 1880).

Horticultural Building.

This building is at the western side of the park and faces on the side of the lagoon. The building is 250 by 1,000 ft., covering 5.8 acres, and cost $300,000. The architect is Mr. W. L. B. Jenney, of Chicago. The plan comprises two end pavilions, each connected to a central pavilion by front and rear curtains, forming two interior courts each 88 by 170 ft. Over the central pavilion is a glass dome 187 ft. diameter and 113 ft. high, under which will be placed tall palm trees, bamboos and tree ferns. There is a gallery in each of the pavilions, those in the end ones being intended for cafés. The exhibits specially requiring sunshine and light will

be in the rear curtains, where the roof is entirely of glass, and not too far removed from the plants. Provision is made for heating certain parts. The interior courts will be decorated with ornamental shrubs and flowers. In front of the building, and extending to the edge of the lagoon, is a flower terrace for outside exhibits, including tanks for nymphæa and victoria regia. The terrace is bordered by a low parapet decorated with vases, and at the middle of the terrace is a boat landing. The coloring will be in an ivory tone, relieved by rose color.

Illinois State Building.

This will be the largest of the state buildings, in consequence of the exposition being located in the State of Illinois. It is situated on a terrace at the upper end of the park. It was designed by W. W. Boyington & Co., of Chicago, and cost $250,000. The main building is 450 by 100 ft., covering 1.7 acres. On the north side is Memorial Hall, forming a wing 50 by 75 ft., and on the south side is a wing 75 by 123 ft. The latter is three stories high, the two lower ones containing the executive offices and the third having two public halls. At the center of the building is a dome 72 ft. diameter, the top of which is 235 ft. above the ground. The side walls are 47 ft. high, the ends 54 ft., and the south wing 72 ft. high. The building is of wood, stone, brick and steel, and is covered with staff. The main entrance is on the south, fronting on the lagoon, and there are other entrances on the sides, all having terraces and broad flights of steps. The interior is lighted by side windows 14 ft. above the floor, to allow of exhibits being placed against the walls, by skylights in the flat roofs of the side aisles, and by continuous skylights in the ridge of the pitched roof over the nave. Ventilation is provided for through windows placed a story above the flat aisle roofs and the foot of the pitched roof. There will be no competitive exhibits in this building, but exhibits illustrating the resources of the State, its methods of government, natural history, geology and topography, etc., and there will be five model common school rooms, fully equipped and furnished under the direction of the State Superintendent of Public Instruction. Memorial Hall is to contain relics, war trophies, etc., owned by the State. This hall is fireproof and has a gallery around it.

ILLINOIS STATE BUILDING.

Machinery Building.

This is one of the main buildings and forms one side of the central plaza. It is 800 by 500 ft., covering an area of 9.8 acres, and the estimated cost is $1,200,000, including the annex. The architects are Peabody & Stearns, of Boston, Mass. The architectural design of the main front is upon classical models, with details in the style of the Spanish renaissance, modeled from buildings in Seville and other cities. The main front is richly decorated. The rear elevation, toward the stockyards, will be very plain. As in most of the buildings, an arcade on the first floor permits of passage round the building under cover. The constructive design of the building is that of three iron train sheds side by side, the three sets of roof trusses covering the main space, which has a gallery 50 ft. wide on each side. It is hoped to sell these trusses for train sheds or other railway purposes after the close of the exposition. In each of the three naves will be an overhead traveling crane for use in the erection and placing of exhibits, and these will be fitted with platforms and used for carrying visitors. Shafting for power will be carried by the columns for these cranes, and steam will be supplied from a main power house on the south side of the building, containing a powerful battery of boilers of various kinds and makes. A colonnade, with a café at each end, forms the connection between the Machinery and Agricultural buildings. At the western end of the building is the Machinery Annex, 490 by 551 ft., with an area of 6.2 acres. This is built of wood, and the constructive design is that of a mill or foundry. It will have a nave 100 ft. wide, with a leanto each side 50 ft. wide. Power will be transmitted by shafting crossing the building at each bay, with a motor to each line of shafting. Steam power will be used in the main building, and electric power in the annex. The color will be of a yellow tone.

Manufactures and Liberal Arts Building.

This will be the largest building of the Exposition, and the largest exposition building ever built, covering a rectangular space 1,687 by 787 ft., with an area of 30.5 acres. The estimated cost is $1,000,000. The building is situated on the lake front. It was designed by Mr. George B. Post, of New York, and is in the Corinthian style of architecture, with an imposing effect of columns and arches, relieved by pavilions at the corners and at the middle of each façade, and decorated by elaborate ornamental details. In all the pavilions are lofty arched entrances. The four main entrances are in the middle pavilions and have each a central archway 40 ft. wide and 80 ft. high. The long façades of the great hall surrounding the building are composed of a series of arches with great glass windows. The lower portion of these arches, up to the level of the gallery floor, is open to the outside, forming a covered loggia or open promenade. Within the building is a main gallery 50 ft. wide, extending round the four sides, and having 86 projecting galleries 12 ft. wide. The galleries are approached from the main floor by 30 stairways, the flights of which are 12 ft. wide. The floor space of the building and galleries is about 40 acres. The main roof covers a space 380 by 1,400 ft. The original intention was to have an interior court, but in consequence of the great demand for space it was decided to cover in all the enclosed area, and this will be spanned by a great roof of three-hinged semicircular arch trusses, 368 ft. span and 210 ft. high, being the largest roof trusses in the world. This roof was designed by Mr. E. C. Shankland, the Engineer of Construction.

Mines and Mining Building.

This building is one of the group fronting on the central plaza. It is 700 by 350 ft., covering 5.6 acres, and the estimated cost is $260,000. It was designed by Mr. S. S. Beman, of Chicago, and its style of architecture is that of the Italian renaissance with a French treatment well subordinated. The main fronts are 65 ft. high. There is an entrance on each side, the main entrances, 32 ft. wide and 110 ft. high, being on the north and south sides. At each corner is a pavilion 68 ft. square and 90 ft. high, surmounted by a low dome. Around the interior is a gallery 60 ft. wide and 25 ft. above the floor, approached by eight stairways and lighted by side windows and a clear story. Between the main entrances and the pavilions are arcades forming an open loggia on the ground floor and a deeply recessed promenade on the gallery floor level. These covered promenades are each 25 ft. wide and 230 ft. long, with numerous points of access to the galleries. The loggias will be faced with marble, forming a part of the exhibits. The interior area, surrounded by the galleries and the space beneath them, is 630 by 230 ft., and is spanned by steel cantilever roof trusses supported on steel columns, with a clearstory along the ridge. The trusses are 65 ft. apart. The center span is 115 ft. c. to c. of columns, and the cantilever side spans are 57 ft. 6 ins. The height is 100 ft. at the middle and 47 ft. at the side. Owing to the distance between trusses, riveted lattice purlins are used. The greater part of the roof is covered with glass.

Transportation Building.

The building is located on the western side of the park, and its exhibits will be among those of special interest to engineers and railway men. It is 960 by 250 ft., with an area of 5.5 acres and the estimated cost is $280,000. The architects are Adler & Sullivan, of Chicago. The architectural design is Romanesque, with a plain and simple general treatment but very elaborate detail work. The main entrance will be on the east side, and will be a single arch of large span, deeply recessed and highly decorated with carvings, bas-reliefs and mural painting. This entrance will be called the Golden Door, the decorative work being entirely treated in gold leaf and studded with incandescent electric lights. The main front consists of a consist of a continuous arcade, with subordinated colonnade and entablature, and having numerous minor entrances to the building. The interior has a broad nave and aisles. Over the nave is the main roof, and forming a clearstory with windows in the sides, the side roofs rising above. At the middle of the building is a cupola, the top of which is 165 ft. above the ground. This will be reached by elevators, carrying visitors also to the main galleries, and these and other elevators will form a part of the exhibits. At the rear of the building, and extending to the roadway along the inside of the park fence, is the Transportation Annex, covering nine acres. This building will consist of a row of one story shed roofs 64 ft. wide and placed side by side, with railway tracks running east and west at intervals of 16 ft. Here will be the special railway, locomotive and rolling stock exhibit, which will be very extensive and interesting. Across the annex will be a transfer table for moving the engines, cars, etc. The exhibits in this building will include every kind of transportation by land and water, a very wide and comprehensive subject, ranging from pack saddles and rafts to locomotives, cars, carriages and steamships. A description of the scope of these exhibits, with the official classification, was given in Engineering News, Sept. 26, 1891. The coloring of the Transportation Building will be yellow and red, the Spanish colors, and will be enhanced by much gilded work.

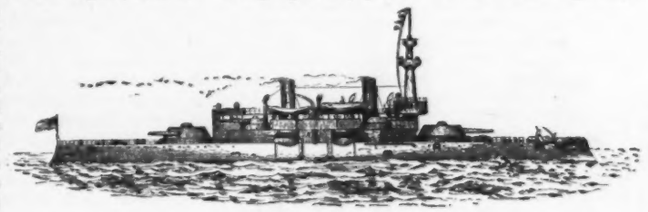
United States Government Building.

This building is located near the middle of the lake front of the park, having a wide, open space between it and the lake. It is of the classic style adopted in the National Museum and other government buildings at Washington, and was designed by Mr. Windrim (now Director of Public Works at Philadelphia, Pa.), when U. S. Supervising Architect, which position is now occupied by Mr. W. J. Edbrooke. It is of iron, brick and glass, covering a space 420 by 350 ft., with an area of 3.4 acres, and will cost $400,000. The main front is to the west, and on the north side is a bridge across the lagoon to the Fisheries Building. At the center of the building is an octagonal dome 120 ft. diameter and 150 ft. high from the floor. Beneath this dome the floor will be kept free from exhibits. There are 9,000 sq. ft. allotted to the exhibits of the Post Office Department, 10,500 sq. ft. to the Treasury Department, 23,000 sq. ft. to the War Department, 23,250 sq. ft. to the Department of Agriculture, 24,000 sq. ft. to the Department of the Interior, and 20,000 sq. ft. to the Fisheries Commission. Space will also be allotted to the Department of State and Department of Justice. The exhibits will include collections of coins and paper money, photographs of public buildings, a relief map of the United States 400 ft. square, a military hospital and hospital corps, lay figures in the various uniforms of the United States army, and heavy ordnance and projectiles for artillery drills.

United States Naval Exhibit.

An interesting and novel feature will be the exhibit of the U. S. Navy Department, consisting of a full size model, in brick and concrete, of one of the latest types of battle ships. It is an exact model of two of the ships now being built, which were designed by the Bureau of Construction. It is built on piles in shallow water, at about the middle of the lake front of the park, being approached from a wooden trestle, and will be appropriately named the "Illinois." The hull is 348 ft. long, 69 ft. 6 ins. beam, and the height from water line to main deck is 12 ft. On the middle of this deck is a superstructure 8 ft. high, with a hammock berthing 7 ft. high, and above this are the bridge and pilot house. The boats are also carried above this superstructure, from the middle of which rise the two smokestacks, and at the forward end is a conical steel military

mast, having two armored tops equipped with Gatling guns. The top of this mast is 76 ft. above the water line. Rising through the main deck, in front of each end of the central superstructure, is an armored turret, carrying 2 13-in. breech loading rifles. Besides these four heavy guns, there are 8 eight-inch and 4 six-inch breech loading rifles, 20 six-pounders and 6 one-pounder rapid fire guns, 2 Gatling guns and 6 torpedo tubes. Along one side is rigged a torpedo netting. On the berth deck will be exhibits of ordnance implements, range finders, torpedos and the various fittings of war ships, and in the superstructure will be the men's quarters, galley, mess rooms, etc. The ship will be completely equipped with guns, boats, search lights, deck fittings, etc., and will have a small complement of officers, seamen and marines, showing the discipline and mode of life on board a war ship. It is intended to have exhibition drills in gun, boat, torpedo and sword practice, etc. The cost of this exhibit will be $100,000. It was suggested by Capt. R. W. Meade, U. S. N., and the plans were prepared in the Bureau of Construction, of the Navy Department, under the direction of Lieut. E. D. Tausig, U. S. N.



U. S. NAVAL EXHIBIT.

Woman's Building.

This building is centrally located, fronting on the lagoon, and has a very attractive and pleasing appearance. It was designed by Miss Sophia G. Hayden, of Jamaica Plain, Boston, Mass., to whom was awarded the prize of $1,000 offered by the Board of Lady Managers for the best design. The second and third prizes were awarded respectively to Miss Lois L. Howe, of Boston, and Miss Laura Hayes, of Chicago, and nearly all the decorative work, figures and groups have been designed by women. The building is 400 by 200 ft., with an area of 1.8 acres. This will cost $120,000. The style of architecture is that of the Italian renaissance, with the first story in the Doric and the second in the Ionic order. There are end and middle pavilions, which are connected in the first story by open arcades in the curtains. The first story is about 10 ft. above the ground. In the middle pavilion is the main entrance, which has three archways and is approached by a flight of steps from a terrace on the lagoon, the terrace being 6 ft. above the water and 100 ft. from the building. Above the entrance, on the second floor of the pavilion, is an open colonnade, surmounted by a low pediment on which is an elaborate device in bas-relief. The main cornice is an elaborate decorated frieze extending the whole length of the building. The corner pavilions have two stories and are 60 ft. high, with open gardens on the roof, surrounded by a colonnade consisting of caryatides supporting a light cornice. The rest of the building is covered with a low Italian roof. At the middle of the building is an open space 70 by 65 ft., extending to the roof and covered by an ornamental skylight. This gives ample light to the interior and is surrounded by a two-story open arcade, the effect being that of an Italian courtyard. The main hall is 240 by 60 ft., with a room 80 by 20 ft. at each end. On the first floor are a model hospital and model kindergarden, each 80 by 60 ft., a library, bureau of information, etc. On the second floor are the parlors, committee rooms and dressing rooms. The second floor of the north pavilion contains a club room and an assembly rooms, 120 by 80 ft., and that of the south pavilion contains a refreshment room, reception room and kitchen for demonstrations. The exterior work is entirely of staff, colored an ivory tone and relieved with yellow.

Report of Progress.

The following notes of the work done during January, since the progress report in our issue of Jan. 16, and the condition of the work at the end of the first week in February, are abstracted from published particulars. In January there were only 14 working days, owing to the cold and stormy weather. The ground was frozen to a depth of 18 ins. and excavation work was impossible, even by the use of dynamite, which was unsuccessfully tried on the site for the machinery annex. During the month there were used in construction 1,636,962 lbs. of ironwork, 5,867,360 ft. of lumber and 10,236 pieces of staff, while 50,622 pieces are ready to be placed. There will be required for the complete work 109,402 pieces of staff, of which 18,270 are in place and 50,622 ready to be placed. About one-sixth of the total amount for the exterior covering is now in place. This covering is now being made for all but the Fine Arts and Machinery buildings, and none has yet been placed on the U. S. Government or Illinois State buildings. It is now being placed on six of the buildings.

Much interior work, lathing, plastering, painting, glazing, skylight setting and staff setting, has been done on several of the buildings, and this work is being vigorously pushed. A few weeks ago there were only carpenters, iron workers and laborers employed, but on 7 of the 13 buildings in course of erection there are now employed roofers, skylight men, lathers, plasterers, painters, glaziers and staff setters, and the number of these men will be steadily increased.

Administration Building.—The iron frame of the central part of the building is completed to the springing of the dome, and work is in progress on the dome. The four pavilions are ready for window sashes. The exterior staff covering is being placed, the work being done in heated sheds placed against the walls to prevent the material from freezing, and about half of the covering is already in place. Much of the interior finishing work is being done.

Agricultural Building.—The iron roof columns are being erected and the carpenters are at work on the heavy work of the second story. The roof and skylight have been commenced.

Electrical Building.—In January, twelve of the steel roof trusses were erected, but the carpenter work has progressed rather slowly, although much of the heavy work is under way.

Fine Arts Building.—The walls average one story in height, and about 5,235,000 bricks have been laid. Iron girders and columns are being erected. No exterior covering has been placed yet.

Fisheries Building.—The walls of the main building are completed, the gallery trusses erected and a large proportion of the window frames and sashes put in. The iron work of the aquarium is completed. The interior work is in progress and three-fourths of the exterior covering put on, the latter work being done in heated sheds, as noted above.

Forestry Building.—This is ready for the interior plastering. The skylight and felt roofing are done, and stoves have been put in to heat the building for the model makers.

Horticultural Building.—The iron work of the dome was completed in January, and the skylight placed in the roof of the west curtain. The two end pavilions are completed and roofed in. Much interior work has been done, and of the exterior covering about one-sixth has been placed, heated sheds being used as in other buildings.

Illinois State Building.—No ironwork has yet been erected.

Machinery Building.—Little work was done in the early part of February beyond that noted in Engineering News, Jan. 16, but the contractor has a large amount of the ironwork on the ground. Heavy carpentry work is in progress.

Manufactures and Liberal Arts Building.—The heavy carpentry work is progressing, about 300 carpenters being employed. The exterior walls and pavilions are going up, the north and east pavilions are ready to be roofed. Between the pavilions the columns are up to the gallery and the joists of the second floor are laid. No iron has yet been erected either on this or the Illinois State Building.

Mines and Mining Building.—Much of the interior work has been done and about one-sixth of the exterior covering placed by the aid of the heated sheds above referred to.

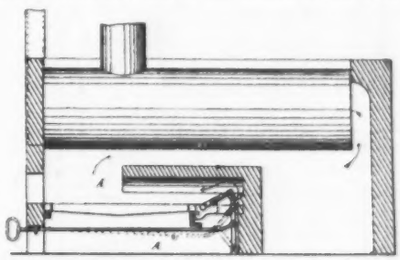
Transportation Building.—The exterior walls are practically finished, the roof trusses are erected, the gallery floors laid, and the stairways are being built. About 10,324 sq. ft. of skylight glass has been put on.

United States Government Building and Naval Exhibit.—Comparatively little progress has been made on either of these since the report in our issue of Jan. 16.

Woman's Building.—The interior work is in progress and well advanced, and the glazing and skylight work are nearly finished. About three-fourths of the exterior covering has been placed.

A STATIONARY BOILER FURNACE WITH BRICK ARCH.

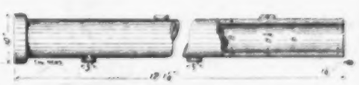
The brick arch, which has found so much favor in locomotive practice, has not been much used with stationary boiler furnaces. The demand for smokeless combustion, however, is causing more attention to be paid to devices for keeping an even temperature in the furnace and securing a thorough mixture of the gas from the fuel and the entering air current. In a furnace just brought out by the Backus Company, of Detroit, Mich., the rear half of the grate is covered by a brick arch, and air from the ash-pit is admitted at the rear of the grate through a hinged inclined section. The arrangement will be readily seen by reference to the accompanying sketch. Boilers fitted with this furnace are in use at the printing press manufactory of R. Hoe & Co. in New York City, and at the station of the Syracuse (N. Y.) Heat & Power Co., of which Mr. Ira A. Holly is Superintendent. The combination of the arch, bridge wall, and mechanism for admitting air at the rear of the grate is covered by U. S. patent No. 463,023, dated Nov. 10, 1891.



The Backus Smokeless Furnace.

A NEW GAS AND WATER PIPE.

The cut here given shows an improvement in the manufacture of gas and water pipe, invented by Mr. George Richardson, of Bridgeport, Conn. In a 12-ft. length of pipe four projections, each about 3 ins. in diameter and 1¾ ins. in total thickness, are cast for the purpose of enabling the pipe to be tapped without shutting off the water. Another advantage is that owing to the thickness of the tapping-boss the tap itself can not project inside the pipe, as is too often the case with present methods. No tapping machines are required with this pipe.



Richardson Gas and Water Pipe.

JAPANESE ROAD LAW.

Japan has had good roads for some centuries, and the Kioto-Tokio highway, 307 miles long, was noted for its excellence as long ago as 1691, when it was traveled by the Dutch explorer Kaemfer. But as their new civilization introduced new vehicles of traffic, the Japanese, in 1875, framed new laws for the general construction and maintenance of highways. This law, by which all roads are classified, is modeled somewhat on the French system and divides them into national, prefecture and village roads. The national roads are built and kept in repair by the state, the work being done by the prefectures

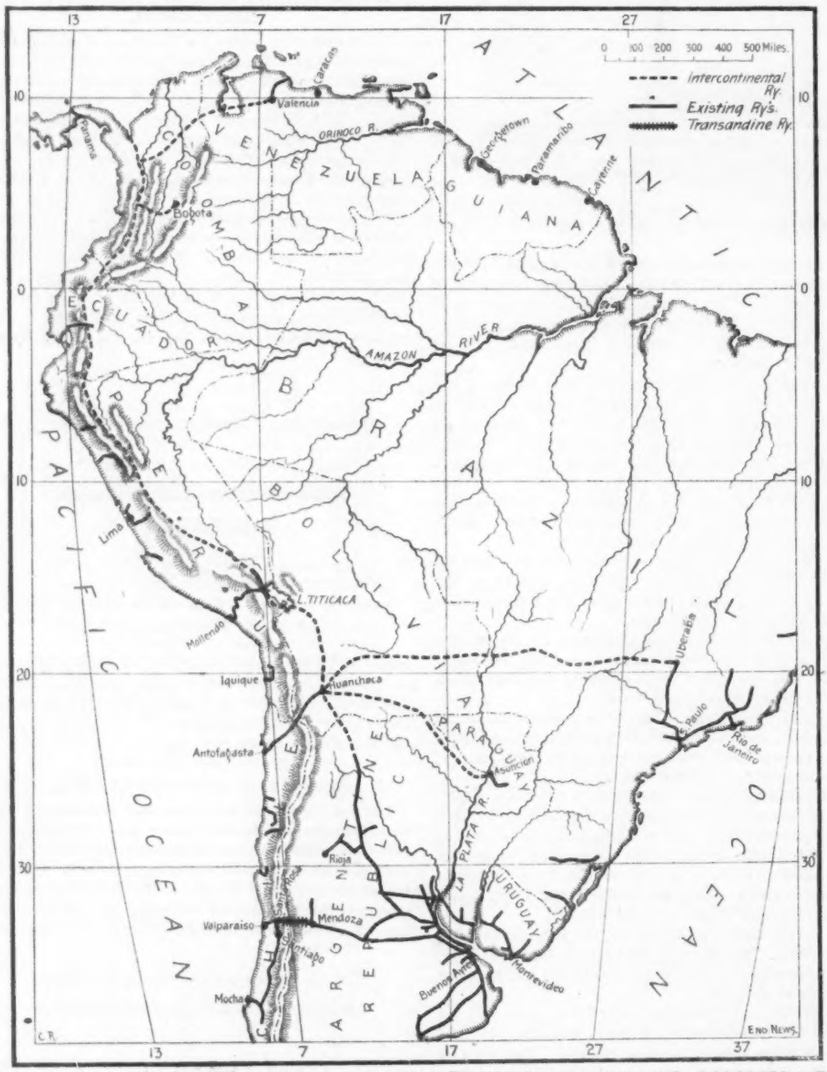
along the line. The second class of roads is kept up at the joint expense of the state and the prefectures, each paying one-half. And the village roads are built and maintained by local taxation under the engineering authority of the prefecture. The administration is said to be excellent, and what money is expended is in the line of efficient work. The Japanese are evidently far ahead of American legislators in their methods, and they are wise in early introducing these road laws into the remodeling of their empire.

THE PROPOSED INTERCONTINENTAL RAILWAY.

Probably the most interesting work, at least to our readers, of the "Pan-American Congress," held in Washington in the early months of 1890 to consider plans for securing closer traffic and commercial relations between the republics of North and South America, was the step taken toward the construction of a railway connecting the principal nations of the two continents. In our issue of Sept. 6, 1890, we published an abstract of a preliminary report upon the feasibility of an intercontinental railway, together with a map showing the possible routes for such a line, presented to the congress by Lieut. Geo. A. Zinn, Corps of Engineers, U. S. A. Within the last few weeks another report has been made by Mr. L. J. Blanco, a member of the congress from Venezuela, which gives a review of the work done thus far and the general route of the proposed road as agreed upon. From the telegraphic abstract of this report given in "Bradstreet's" we take the following details:

The railway systems of the United States and Mexico being continuous the only consideration has been the selection of a route through Central and South America. As decided upon the new line will connect with an extension of the Mexican railway system at Ayutla, on the Guatemala frontier, and run thence via Rotahulea and Mazatonango to Santa Lucia. From Santa Lucia the line will run via Guatemala and Escuintla to Santa Ana, in the Republic of Salvador, and thence via San Salvador, Cojutepeque, San Miguel and San Vincent to Guascoran, in Honduras. Leaving Guascoran the line will follow the shore of the Gulf of Fonseca to Cholutica, in the state of that name, and run south to Chinandega, in Nicaragua. From the latter point the line o the railway from Corinto to Lake Managua will be used as far as Pueblo Viejo, where the line will branch off, following the west shore of Lake Managua to the town of Managua, and connect there with the railway already built between Managua and Mazaya. From Mazaya the proposed line will follow the west shore of Lake Nicaragua to Rivas, and thence into the territory of Costa Rica to Alajeula from which place the railway from San Jose to Puerto Limon will be used. From Puerto Limon the line will continue through the Isthmus of Panama by a route not yet determined to the entrance of the Aratro Valley on the frontier of Colombia.

This brings the line to South American territory, on the frontier of its northernmost state. From here the proposed line will follow the western Cordillera of the Andes, passing through the Cauca valley to the town of Anticqua, and run thence to Popayan, in the United States of Colombia. From Popayan the line will follow what is known as the central plateau route, passing through the Patia Valley to Pasto or Ipiales and thence to the northern boundary of Ecuador. In this last state the line will touch the towns of Tulcan, Ibarra, Quito, Latacunga, Ambato and Cuenca and enter Peruvian territory near the town of Loja. In Peru it will follow the valley of the River Maranon to Cerro de Pasco, whence it will follow the course of the Perene up to a suitable point for a deviation to Santa Ana, and thence to Cuzco, Santa Rosa and Pasco, and skirting Lake Titicaca enter Bolivia. In this state it will connect the towns of La Paz, Aruro and Huanchaca, and divide into branches going to Chile, the Argentine Republic, Brazil, Paraguay and Uruguay.



MAP OF RAILWAYS OF SOUTH AMERICA, INCLUDING TRANSANDINE RAILWAY AND PROPOSED INTERCONTINENTAL RAILWAYS.

The general routes of these several branches are as follows: The Chilean branch will run from Huanchaca, in Peru, to Antofagasta, on the Pacific coast in Chile and is already completed. The branch to the Argentine Republic, already surveyed, will run from Huanchaca to Jujuy. The branch connecting Paraguay and Uruguay with the main line will start from Huanchaca and will follow the left bank of the Pilcomayo River to Ascuncion, where it will connect with the so-called Osborn concession for a railway from Ascuncion to the north of Paraguay. At Ascuncion, connection will also be made with lines already constructed or in process of construction as far as Montevideo, in Uruguay. The branch to Brazil will run east from Huanchaca along the Paraguay River to Crumbao, where it will enter the territory to Brazil and follow the Taguary River as far as Coxim. From Coxim a concession has been granted for a railway as far as Uberaba, where connection will be made with lines already built to Rio de Janeiro.

In addition to these branches a branch will connect Venezuela with the main line at some point in the Cauca Valley in Colombia. It will run east to its connection with the main line to Medellin, where connection will be made with the line from that town to Punto Berrio, on the Magdalena River, whence it will reach in succession Bucaramanga, San Jose de Cuitica, San Cristobal, La Grita, Meridu, Trujillo and Barquisimeto, and terminate at Valencia. From Valencia a railway is now being built to Caracas. The accompanying map gives the route of the proposed line and its branches in South America.

The route thus briefly outlined is, of course, general. Further investigation into the resources and geography of the countries traversed may cause it to be changed in many particulars, but at present it appears to be the route best adapted to serve the interests of the several countries. Thus, while the report decides nothing definitely, it is an indication that something tangible may result from the proposed scheme.

SAND FEEDING APPARATUS FOR LOCOMOTIVES.

We illustrate herewith a sand feeding apparatus for locomotives patented by Mr. H. L. Leach, Jr., Master Mechanic of the Fitchburgh Railroad, Keene, N. H. This invention was the result of an endeavor

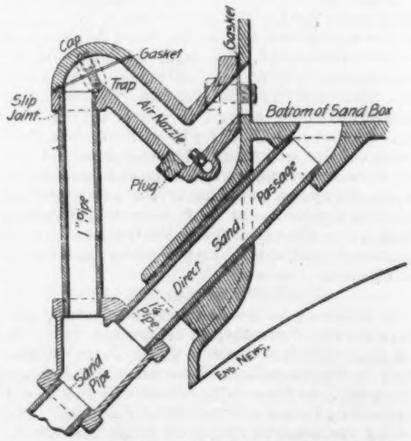


Fig. 1. Leach's Sand Feeding Apparatus for Locomotives.

to find a satisfactory method of feeding sand under freight engines on heavy grades, where the trains were often stalled by the too profuse sanding of the track. It is also intended to prevent the rapid wear of rails and tender wheels and to avoid the expense due to hauling trains over large quantities of sand left on the rails when it is fed by means of the ordinary sand lever. The apparatus has been tried and adopted by a number of railways, including the Fitchburg, the Boston & Maine, the Maine Central, the Old Colony, the Boston & Albany, the New York, Providence & Boston, the Beech Creek, the International & Great Northern, the Atlantic Coast Line, the Fall Brook Coal Co., and others.

In this device the sand is fed by means of a jet of compressed air, and its operation will be readily understood from the accompanying cut, Fig. 1. The sand trap is represented as bolted over a hole in the side of the sandbox, through which the sand flows freely into the trap, from which it is blown by an air jet through a nozzle at the bottom of the trap over into the usual sand or delivery pipe, through which

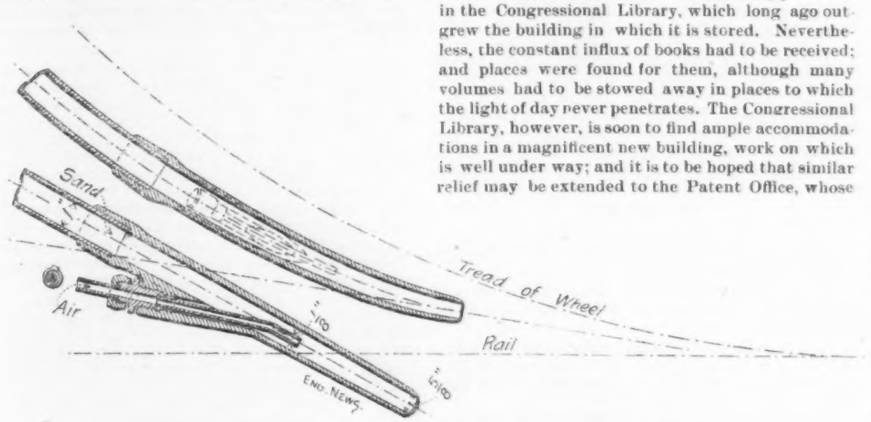


FIG. 2.—GRESHAM'S SAND JET APPARATUS FOR LOCOMOTIVES.

it falls to the rails. The direct passage from the sand box to the delivery pipe, and the usual valve and connections from the cab, are generally retained and may be used to assist the brakes in making emergency stops. The compressed air used is taken from the main reservoir of the air brake system and passes to the traps through suitable piping, the feed being regulated by a valve located in the cab convenient to the engine driver. Very little air is required, and a pressure of 1 to 5 lbs. through a nozzle $\frac{1}{32}$-in. diameter will blow the small amount of sand required to prevent the driving wheels from slipping.

This arrangement of trap is not adapted to the form of sandbox most generally used, for which form, in applying the apparatus to old engines, the trap is bolted to a lug formed on the side of the sandbox base, in a similar manner to that employed in fastening the usual sandpipe flange. An independent passage through the base of the sandbox is provided to convey the sand to the trap. The operation, however, is the same as above described. In another form of trap the 1-in. pipe from the trap is brought round parallel to the direction of the air jet, and tapped into the direct sand passage at right angles to that passage. The price for a pair of traps with necessary fittings is about $25.

In English locomotive practice it is now very general to apply a sand jet by steam or compressed air, especially on express locomotives having a single pair of driving wheels. The steam or air pipe, however, is generally let into the sand pipe near the level of the rail, the end of the sand pipe being bent so that the stream of sand will be directed right under the wheel. The application of this device is shown in the view of an eight-wheel express locomotive of the Southeastern Railway in our issue of Feb. 22, 1890, and the arrangement of the jet is shown in detail in the accompanying cut, Fig. 2. The apparatus is known as Gresham's sand jet. English locomotives have usually a sandbox on each side, placed in front of the wheel splasher or under the running board. (Eng. News, Feb. 22, 1890, and March 28, 1891.)

NEEDED REFORMS IN THE PATENT OFFICE.

The "Official Gazette" for Feb. 2, 1892, contains the annual report of the Commissioner of Patents, Hon. W. E. Simonds, and the appeal which he makes to Congress for the facilities which are absolutely essential for carrying on the business of the Patent Office is one which ought to be heeded. The most pressing and immediate need is more room. The number of patents of the present series now amounts to nearly 480,000, including reissues, and printed copies of each of these patents must be kept on file. The number of copies of patents sold annually is about 600,000, and about as many more are used each year by the office itself and by other Government departments. These files are now kept in parcels under stairways and in every possible nook and corner available in five floors of the building. "Where these weekly issues of copies are to be put in the near future," says the Commissioner, "no one at present can possibly tell."

In this connection it is of interest to note the similar condition of affairs that has long prevailed in the Congressional Library, which long ago outgrew the building in which it is stored. Nevertheless, the constant influx of books had to be received; and places were found for them, although many volumes had to be stowed away in places to which the light of day never penetrates. The Congressional Library, however, is soon to find ample accommodations in a magnificent new building, work on which is well under way; and it is to be hoped that similar relief may be extended to the Patent Office, whose work is of far greater importance to the country than that of the Congressional Library.

At present, however, the principal appeal of the Commissioner is for more room for the working force of the office, and he gives a diagram showing the cubic feet of space per occupant in each room used. The average space per occupant is 916 cu. ft. A dozen or so of the most crowded rooms have only 393 to 750 cu. ft. per occupant. It is doubtless true that, considering the necessary amount of reference matter which the examiners must have on hand, they are crowded far too much for convenient work; still it must be said that according to the Commissioner's showing, the crowding is no worse than in many a business office of a private firm, and not much greater, perhaps, than in the average office building in New York City. Still, it is generally conceded that a much larger force of examiners is needed to carry on the business of the office as it should be, and there can be no question that the great mass of valuable archives which have accumulated in the Patent Office should be arranged in a systematic and orderly manner in an absolutely fireproof building.

The Commissioner thinks it possible that the present force of Examiners may be able to keep the work of the office from falling farther behind than it is at present. (At the close of business on Jan. 26, the various examining divisions were in arrears from one to six months.) But even this is by no means sure; and in order to bring the work up to date, to provide for the needs of the immediate future, and to undertake the work of preparing classifications and digests of the patents issued in each of the different divisions, an increase in the working force is necessary. The Commissioner recommends that one new Examiner be added to each of these 32 examining divisions of the office for the above purposes.

To make these much needed improvements, the Commissioner clearly shows that no appropriation is needed save of funds which have been paid into the Patent Office in the shape of fees and have formed a constantly increasing excess over its expenditures, which now amounts to over $4,000,000. This fund does not belong in equity to the nation. The fees paid to the Patent Office are not meant to be a tax or a consideration for a franchise bestowed, but are intended to cover the expenses of the Government in passing upon the inventor's application and keeping record of the transaction. It is with much force, therefore, that the Commissioner reaches his final conclusion, that "In the forum of constitutional intent and good morals, money paid into the Treasury by inventors should be applied for the benefit of the patent system, or at least so much thereof should be so applied as is requisite to the full transaction of the public business connected with that system."

Besides the reforms which are indicated above, the following amendments to the patent law are recommended, the Commissioner in each case stating briefly the grounds on which the recommendation is made:

1. An amendment to the effect that no improvement shall be patentable which has been, for more than two years before application for patent thereon, disclosed in any patent or printed publication issued in this country. Under existing law two years of public use in this country creates such a bar, and, on principle, two years of disclosure in a patent or printed publication should be put upon the same footing.

2. An amendment to the effect that a patent shall not expire with the expiration of a prior foreign patent for the same invention. The existing law upon this subject has been found to work confusion, uncertainty and fraud.

3. An amendment compelling an applicant to take action upon his application at least once in every six months, in lieu of once in two years, as at present; and a further provision that a patent shall in no case live for more than 20 years from the date of the first application therefor. The adoption of such amendments would put an end to keeping applications for patents pending many years prior to issue.

4. An amendment requiring patent licenses to be recorded the same as assignments and grants. Licenses are often so drawn as to convey away the whole substance of a patent, and yet, under existing law, they do not need to be recorded. The same reason that calls for the recording of assignments and grants calls equally for the recording of licenses.

5. An amendment putting aliens upon the same footing as citizens as to the filing of caveats. In all other respects than this our patent law makes no distinction between citizens and aliens, and the retention of this distinction in the statute is clearly an oversight.

6. An amendment abolishing interference contests in the Patent Office and relegating them to the courts. These interferences are, to all intents and purposes, lawsuits between two or more parties who are seeking to patent the same invention. The Patent Office has not the power to compel witnesses to behave properly in these matters. It has not the tribunals adequate for the trial of these causes, and they entail a grievous burden of work upon the office, which, distributed among the different courts, would not be felt as a sensible addition to their labors. Moreover, a court adjudication of one of these cases would be of great practical value to an interference contestant, which value is wholly lacking in an adjudication given by the Patent Office, and the cost of the litigation in a court could not be greater than it is at present.

7. An amendment of the patent law requiring a fee of $10 for every appeal or petition taken from a primary examiner directly to the Commissioner of Patents. The present tendency is to needless multiplication of these so-called interlocutory appeals, upon pretexts many of which are frivolous.

8. An amendment providing that no damages or profits shall be recovered in a suit for infringement, except such as accrue within the six years last preceding the bringing of the suit. The reason for the enactment of this statute of limitation is apparent without detailed explanation.

9. A statute providing that an injunction issued by a court against the transfer of a patent may be registered in the Patent Office and thereupon be constructive notice to all the world. It is believed that the propriety of such a provision is obvious.

10. A statute giving courts of equitable jurisdiction power to pass the title to Letters Patent in a proper case without any action on the part of the defendant. Now the courts must act in such a case by compelling the defendant to sign the necessary conveyance, and a defendant can readily defy the court by putting himself outside of its territorial jurisdiction.

11. A provision in the law to the effect that the Commissioner of Patents may refund to the payer money paid into the Patent Office by mistake. This is the present practice of the office—a practice founded in equity; but it ought to have the express sanction of law.

12. A permanent provision in the statute defining the duties of the Assistant Commissioner of Patents.

13. An amendment to the trade-mark law permitting registry of trade marks which are used in commerce be-

tween the states, the permission now being restricted to trade marks used in foreign commerce, or in commerce with the Indian tribes.

We have briefly commented on these important amendments on our editorial page.

The Commissioner asks for a general increase of salaries of the working force, and this too is a reform of whose propriety there can be little doubt, as has often been pointed out.

The report of the work done by the office in 1891 shows the following totals:

Applications for patents for inventions	39,418
" " " " designs	1,025
" " reissues of patents	109
" " registration of trade marks	1,906
" " " " labels	608
Caveats filed	2,408
Disclaimers filed	29
Appeals on the merits	1,136
Total applications, etc., requiring investigation	46,729
Patents issued, including designs	23,164
Patents reissued	80
Total patents	23,244
Patents expired during the year	12,230
Patents withheld for non-payment of final fee	3,456
Aggregate receipts of office	$1,271,285
" expenditures of office	1,139,713
Surplus for year	$131,572
Total balance in U. S Treasury on account of the patent fund Jan. 1, 1892	$4,004,317

In appendices to the report some interesting statistics are given showing the growth of the patent system in the century from 1790 to 1890, accompanied by a diagram similar to that published in our issue of April 18, 1891. Out of the 476,271 patents which had been issued up to the beginning of 1892, more than one-fifth were issued to residents of New York. The following shows the states taking highest rank in number of patents issued, also those taking highest rank in number of patents issued per 1,000 inhabitants in the ten years, 1880 to 1890:

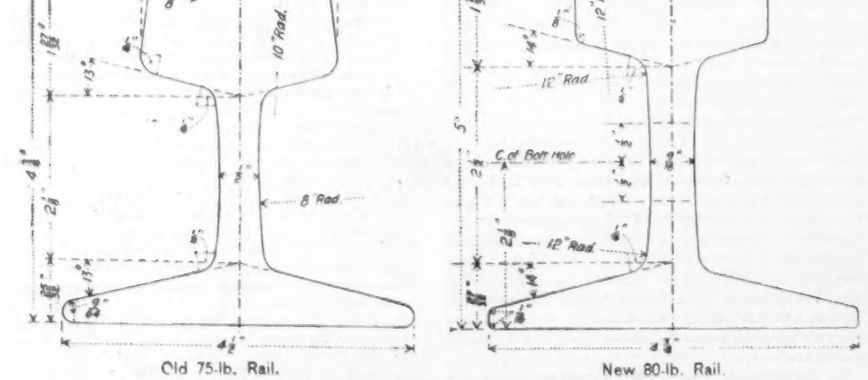
States.	Patents issued 1790 to 1892.	States.	Patents issued per 1,000 inhabitants 1880 to 1890.
New York	101,987	Connecticut	13.1
Pennsylvania	51,140	Massachusetts	10.6
Massachusetts	48,990	District of Columbia	10 5
Ohio	34,606	Rhode Island	10 1
Illinois	33,612	New Jersey	8.1
Connecticut	21,810	New York	7.8
New Jersey	19 650	Colorado	5.9
Michigan	14,111	California	5.8
Indiana	13,138	Illinois	5.1
Missouri	11,066	Montana	4 9
California	9,957	Pennsylvania	4 6
Iowa	8,999	Ohio	4.5
Wisconsin	8,783	Michigan	4.2
Maryland	7,400	New Hampshire	3.8
Rhode Island	6,251	Dakota	3.4
Maine	5,011	Wisconsin	3.2

TRACK OF THE GREAT NORTHERN RAILWAY.

The Great Northern Railway is laying 80-lb. rails on the heavy grades of its Pacific extension from Assiniboine, Mont., to Puget Sound, and we give herewith a section of this rail as well as of the old pattern 75-lb. rail of the same road (formerly the St. Paul, Minneapolis & Manitoba Ry.). The change of section in the new rail shows a decided tendency to conform to the mean type of section prepared from the average dimensions of the individual suggestions made by the members of the committee of the American Society of Civil Engineers on "Standard Rail Sections" (Eng. News, March 21, 1891). The dimensions of these rails are given in the following table:

	Gt. Nor. Ry. 75 lb.	Gt. Nor. Ry. 80 lb.	M'n. Sec. A.S.C.E. 80 lb.
	ins.	ins.	ins.
Height	4¾	5	5
Width of base	4½	4¾	5
Width of head, top	....	2⅛	2¼
Width of head, bottom	2⅛	2⅛	2¼
Angle of side of head	6°	Vert.	Vert.
Depth of head	1⅜	1½	1.477
Height of web	2⅝	2⅝	2.646
Depth of base	⅝	⅝	0.877
Thickness of web	½	⅝	0.630
Height to centre of bolt hole	....	2⅛	.....
Radius of top of head	10	12	12
" top corners of head	3/16	1/8	¼
" bottom " "	¼	1/16	1/16
" top fillets	¼	¼	¼
" bottom fillets	¼	¼	¼
" top and bottom corners of edge of base	....	1/16	1/16
Radius of edge of base	3/16	Vert.	Vert.
" side of web	8	12	Vert.
Fishing angles of head and base	13°	14°	13°

The rails were rolled by the Illinois Steel Co., of Chicago, Ill. They are spliced by angle bars 36 ins. long, with 6 bolts, and a tie is placed under the middle of the joint. The ties are of tamarack and fir, 7 ins. thick, spaced 16 to a 30-ft rail, or 2,816 per mile. The ballast is clean gravel. Mr. E. H. Beckler is Chief Engineer of the Great Northern Railway.



Old 75-lb. Rail. New 80-lb. Rail.

RAIL SECTIONS, GREAT NORTHERN RAILWAY.

PERSONALS.

Mr. P. A. Smith, Resident Engineer of the Texas & Pacific Ry., died at Marshall, Tex., Feb 7.

Mr. A. W. Wildes, of Skowhegan, Me., has been reappointed a member of the Maine State Board of Railroad Commissioners.

Prof. L. M. Haupt has been granted leave of absence until Sept. 30 by the University of Pennsylvania, when he will tender his resignation, and engage in private practice.

Mr. Samuel A. Beardsley, of Utica, N. Y., has been appointed a member of the New York State Board of Railroad Commissioners, vice Mr. W. E. Rogers, whose term has expired.

Mr. J. W. Sanborn, Superintendent of the Northern Division of the Boston & Maine R. R., has been appointed Acting General Manager, vice Mr. J. F. Furber, General Manager, deceased.

Mr. Azariah B. Harris, who died in New York, Feb. 9, was president of the Massachusetts & Southern Construction Co. and of the Vermont Valley R. R. He was also a director of the Connecticut River R. R.

Mr. Edward N. Pike has opened an office in Meriden, Conn., for the practice of engineering, and is prepared to make surveys, plans and estimates for work of all kinds. He will make a specialty of water-works, sewers and hydraulic engineering.

Mr. J. L. Van Ornum has been appointed Chief Topographer of the survey of the United States and Mexico boundary to be made by the International Boundary Commission, under the direction of the Department of State. His office will be at El Paso, Tex. The U. S. Commissioners are Lieut. Col. J. W. Barlow, U. S. Engineers; Lieut. D. D. Gaillard, U. S. Engineers, and Mr. A. T. Mosman, Coast and Geodetic Survey.

Mr. L. F. Bellinger, C. E., formerly of Northfield, Vt., and now of Tallapoosa, Ga., is completing the construction of four miles of street railway. He is Chief Engineer of the Tallapoosa Lumber Mfg. & Railroad Co's. line, and Chief Engineer in charge of the surveys of the Georgia, Tennessee & Illinois R. R. He is City Engineer of Tallapoosa, and has a general professional practice. He is not Chief Engineer of the Tuscaloosa & Maxwell R. R. as reported heretofore.

Mr. Hiram Phillips, St. Louis, Mo., has resigned from the teaching force of the University of the State of St. Louis, at Columbia, Mo., and is now Director of Testing Laboratory and Lecturer on Civil Engineering. He has made the change so as to devote his time to active professional work. He is the special assistant of the Missouri Geological Survey, and is now engaged in examining the stone quarries and ledges of that state. He is collecting specimens and is preparing an exhaustive report upon these and tests of the strength and durability of paving and building stones. As these tests will be extended further than anything attempted before in this line, Prof. Phillips will be glad to have any suggestions from our readers either as to the general scheme of tests or concerning desirable data in this connection.

Prof. Wm. Grey Peck, of Columbia College, died at Greenwich, Conn., Feb. 7, aged 72 years. He was born at Litchfield, Conn., in 1820. He was graduated from the U. S. Military Academy at West Point in 1844 and was breveted Second Lieutenant of Topographical Engineers in the same year. He served during the Mexican War. While he remained in the army he was Professor in Natural Philosophy and Mathematics at West Point. He resigned his commission in 1885 and afterward became Professor of Physics and Civil Engineering in the University of Michigan. In 1857 he was elected Adjunct Professor of Pure Mathematics in Columbia College and in 1859 was promoted to the full professorship. He also filled the chairs of Mechanics and Astronomy in the same institution, having classes in both the School of Arts and the School of Mines. He received the degrees of A. M. and LL.D from Trinity College, Hartford, and that of Ph. D. from Columbia. He was the author of several works on mathematics.

NEW PUBLICATIONS.

A MANUAL OF MINING.—Based on the course of lectures on mining delivered at the school of mines of the State of Colorado. By M. C Ihlseng, C. E., E. M., Ph. D., Professor Engineering, formerly of Columbia School of Mines, New York City. John Wiley & Sons, 8vo, pp. 428, illustrated, $4.

While this volume is necessarily elementary and cannot in the space devoted enter into all the many intricate details of mining, it is an exceedingly useful book in presenting in concise form the latest and best information upon the subject. It is presupposed that the reader has an elementary knowledge of the sciences and of simple machines, but in each case requiring it the controlling theory is given at sufficient length to enable the novice to understand what he is reading about. The work is practical in its nature as the following chapter-heads will testify: Geognosy, preparatory and exploratory work, methods of mining, hoisting machinery, electricity and water power, hoisting operations and conveyances, underground traffic, surface transportation, pumping, ventilating, illumination and hygienic conditions. The second part of the work is devoted to "Practical Mining," and treats of shaft-sinking in good and running ground, timbering, drifts, etc., boring breaking ground, blasting, drills, implements and air compression. The last chapter is devoted to mine examination.

STREETS AND HIGHWAYS IN FOREIGN COUNTRIES.—Reports from the Consuls of the United States on streets and highways in their several districts, in answer to a circular from the Department of State, issued from the Bureau of Statistics, Department of State, 8 vo., paper, p. 592, illustrated. Requests for this publication should be addressed to the Secretary of State.

While these reports are not as a rule written by engineers, they cover the circular of inquiry and give a vast amount of useful and interesting data concerning the construction and maintenance of streets and highways abroad. The reports cover Austria, Belgium, Denmark, France, Germany, Italy, Spain, Switzerland, the United Kingdom, Canada, South America, West Indies, China, Egypt, Australia, etc. It is of course useless to attempt an abstract, but it can be said that the information given generally includes regulations, methods of construction and maintenance, prices, etc.

SOCIETY PROCEEDINGS.

NEW YORK RAILROAD CLUB.—The next meeting will be held at 7.30 p. m. Feb. 18, at the rooms of the American Society of Mechanical Engineers, 12 West 31st St. Members are requested to present topics for informal discussion.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—The annual convention will be held at Buffalo, N. Y., Feb. 23, 24 and 25. Mr. Carl Hering will lecture on "Transmission of High Potentials," and the following papers will be presented: "How to Fire a Steam Boiler," Richard Hammond; "The Allied Powers," Daniel Ashworth; "Switchboards: Their Safety and Operation," M. C. Sullivan; "Aërial Wires," E. F. Peck; "The Alternating Motor," Wm. Stanley, Jr., and L. B. Stilwell; "From the Tannery to the Dynamo," Chas. A. Schieren; "Underground Wiring," E. A. Leslie; "Underground Systems," J. B. Craven; "Municipal Franchise for Quasi-Public Works," Allen R. Foote; "Electric Lighting from a Financial Standpoint," Erastus Wiman.

ENGINEERS' CLUB OF PHILADELPHIA.—At the business meeting on Feb. 6, President James Christie in the chair, and about 50 members present, the President was authorized to appoint from the Committee on Land-locked Navigation a sub-committee to co-operate with similar committees of the Philadelphia Trades League and of the New York Board of Trade and Transportation, with reference to a proposed ship canal across the State of New Jersey, and, at the suggestion of Captain Spencer C. McCorkle, Chairman of the Committee on Land-locked Navigation, appointed Messrs. Rudolph Hering, Fostor Crowell, L. M. Haupt and William Swift as the sub-committee.

Mr. J. J. McKee exhibited a series of lantern slides, illustrating the progress of work upon the pipe lines of the East Jersey Water Co. Mr. Clemens Herschel, the engineer in charge of the works, participated in the discussion which followed.

NORTHWEST RAILROAD CLUB.—At the meeting on Jan. 2, papers on "Car Roofs" were presented by the representatives of several prominent manufacturers, including F. S. Woods, of C. B. Hutchins & Sons.; M. A. Garratt, of F. W. Bird & Co.; Jas. P. Elmer, of Drake & Weir, and J. B. Quigley, of the Freight Car Equipment Co., of St. Louis. The subject of car roofs was reported on by a committee of the Master Car Builders' Association in 1886 and 1887, and Mr. Woods in his paper quoted freely from that report, which objected to metal roofs on account of their liability to puncturing, the collection of frost or moisture on the under side of the roof, and the rapidity of corrosion. Double board roofs, which have so long been the standard, warp and shrink in the hot climate of the Southwest, and require frequent painting.

Besides the objections above mentioned, Mr. Woods said the metal roofs were all of them more expensive than other types, and were more liable to be blown off, owing to the air space between the metal and the roofing boards. The New York Central, after equipping many thousand cars with metal roofs, has returned to the old double board. The Missouri Pacific has used for a long time the Anchor iron roof of St. Louis, but has finally abandoned it on account of poor service, as it requires renewal once in four or five years. Metal sheets for inside metal roofs cost $18 to $25 per car. Outside metal roofs cost 80 to 90 cts. per ft., or $27 to $31 for a 34 ft. car for the metal alone.

The Hutchins roof is the oldest of the plastic type on the market, having been introduced on the Michigan Central twelve years ago, and on the Pittsburg, Cincinnati & St. Louis some eight or nine years ago. At the present time between 50 and 60 companies are using the roof, and the average output of the Hutchins Co. is about 10,000 roofs per year. The Hutchins roof is guaranteed to last the entire life of the car body without repair, accidents excepted. It is so applied as to perfectly protect plates, carlines and purlines from moisture.

Mr. Woods objected to the roofs constructed with roofing paper and an air space, claiming that they were more easily injured in switching, were more liable to be blown off, were more expensive in first cost and were more difficult to repair.

AMERICAN INSTITUTE OF MINING ENGINEERS.—The annual meeting will be held at Baltimore, Md., Feb. 16 to 20. The headquarters will be at the Hotel Hennert, and the sessions will be held at the Johns Hopkins University. At the opening session on the evening of Feb. 16 there will be the presidential address by Mr. John Birkinbine, and there will be sessions for the reading and discussion of papers in the morning, afternoon and evening of Feb. 17. On Feb. 18 there will be an excursion to Annapolis, Md., and a subscription dinner. On Feb. 19 there will be excursions to the Sparrow's Point Steel Works and to various points of interest on the harbor, including Rasin Fertilizing Works, Oil Refineries, Baltimore Copper Smelting Works, Chesapeake Pottery, and the Columbia Iron Works, where two U. S. cruisers are now being built. In the evening there will be a concluding session, if the business of the meeting should require it. On Feb. 20 there will be short excursions to the Belt Line Tunnel (Eng. News Dec. 12, 19, '91, and Jan. 2, '92.) and the Loch Raven Water-Works.

The following papers have been announced:

"The Mining of Gems and other Minerals in Hungary, Bohemia and Russia," George F. Kunz; "Southern Phosphate Deposits," G. H. Eldridge; "Experiments with the Roesaler Converter at the Marsac Refinery, Park City," C. A. Stetefeldt; "The Control of Silicon in Pig Iron," William H. Morris; "The Great Gossan Lead of Virginia," Edgar C. Moxham; "The Simultaneous Production of Ammonia, Tar and Heating Gas," Alphonse Hennin; "Eastern Kentucky Coals and Cokes," Jos. H. Allen; "La Gardette: the History of a French Gold Mine," T. A. Rickard; "Granulating Magnetic Iron Ore with the Sturtevant Mill, at the Croton Magnetic Mine," W. H. Hoffman; "High-Pressure Hydraulic Presses in Iron Works," R. M. Daelen; "Notes on the Selection of Iron Ores, Limestones and Fuels for the Blast Furnace," Fred. W. Gordon; "The Iron Ores of Ashe County, N. C.," H. B. C. Nitze; "Zinc Mines and Mining near Webb City, Mo.," Carl Henrich; "The Preservation of the Hearth and Bosh Walls of the Blast Furnace," James Gayley; "The Rock Drill Applied to the Opening of Blast Furnace Holes," Daniel Baker; "A New Method for Removing Skulls from Direct-Metal Ladles," Daniel Baker; "Notes on the Geological Origin of Phosphate of Lime in the United States and Canada," Walter B. M. Davidson; "Extraction of Ore from Wide Veins or Masses," G. D. Delprat; "Ancient Method of Silver Lead Smelting in Peru," Otto F. Pfordte. There will be a special discussion of the subject of "Phosphates," on Feb. 17, and discussion is also invited on the subject of "Tests and Requirements of Structural Wrought Iron and Steel."

ENGINEER'S CLUB OF ST. LOUIS.—At the meeting on Feb. 3 Mr. A. L. Johnson read a paper on "Shop Work Inspection." He spoke of the difficult position of the inspector, the duties he has to perform and how best achieved. The processes of manufacture in mill and shop were taken up in detail and discussed. He opposed as unnecessary the requirement in the specifications for ¾ in. round blow tests for steel, and thought open hearth steel more reliable than Bessemer. He favored only one reaming in the shop, the holes being punched 1/16 in. smaller than the diameter of the rivet and then reamed after assembling. This would assure much better, more solid holes. The unreliability of machine countersunk rivets was also mentioned and some reasons given therefor. The paper gave a method for keeping a very rigid account of the daily progress of all the parts of the structure under contract from the mill to the finished member. This is especially advantageous in case any legal complications arise about the delay of the work. Tables were also given for the facilitation of the inspection and a more perfect record of the shop work.

President Johnson introduced Mr. Robert Burgess, one of the engineers of the intercontinental railway survey, who gave a short description of the work of the survey in the northern part of South America, and said that the work, as far as it had progressed, showed that it would be perfectly feasible to construct an intercontinental railway. This railway is described in another column.

ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.—The seventh annual meeting was held at the Grand Pacific Hotel, Chicago, Jan. 27-9. Prof. Arthur N. Talbot in the chair, who also delivered an address. The following papers were read and discussed, in addition to several committee reports and special subjects for discussion: "The Necessity For and Proper Construction of Brick Culverts on the Public Highways," by G. W. Gastman: "Field Measurements for the Granite Viadust at Granite, Idaho," by E. J. Cantine; "Report of Committee on Land and City Surveying," "The Qualities of Water for Domestic Supply and Boiler Use," by D. W. Mead; "State Inspection of Bridges," by E. A. Hill; "Roadways," by F. D. Balcom; "Projected Drainage of Lima Lake," by A. H. Bell; 'Notes on Drainage Surveys," by E. H. Whitaker: "A Plan for Making an Equitable Assessment of Land for the Expense of Artificial Drainage Outlets," by C. G. Elliott; "The Most Convenient Form and Practical Method of Laying Out the Celebrated Kite-shaped Race Track," by D. H. Davidson; "Sewerage System of Jersey-ville Ill.," by S. A. Bullard; "How to Drain a Piece of Land," by J. L. Clark.

The following officers were elected for the ensuing year; President, Samuel S. Greely, Chicago; Vice-President, J. D. Stanford, Chatsworth; Executive Secretary and Treasurer, Samuel A. Bullard, Springfield, Ill.

CENTRAL RAILWAY CLUB.—The annual meeting was held on Jan. 27 at the Iroquois Hotel, Buffalo, N. Y. The report of the secretary and treasurer showed a membership of 138, a gain of 20 over 1890. Supt. Morford, of the Michigan Central, presented, on behalf of a committee of the Buffalo Association of Railroad Superintendents, a communication from the local freight agents of Buffalo and vicinity, proposing amendments of the Rules of Interchange providing that cars once delivered shall not be set back for repairs or transfer, that repairs shall be made at the expense of the delivering road, and that a more general use of defect cards be permitted, so that cars may be kept off the repair tracks. Messrs. John Mackenzie, A. M. Waitt, J. R. Petrie, F. B. Griffith and John Kirby were appointed a committee to consult with the superintendent's committee on the proposed changes.

The committee on wheel-defect gage presented the proposed new standard gage illustrated in our issue of Jan. 23. It was voted that the gage be sent to the Arbitration Committee of the Master Car Builders' Association with the approval of the club. The discussion brought out the fact that flanges of chilled wheels have been made thicker in recent years, also that a uniform flange and uniform distance between backs of wheels was an urgent necessity.

A paper was read by Mr. P. H. Griffin, President of the New York Car Wheel Works, on car wheels and brake service. He said that the use of brakes caused probably the greatest strain on the wheel of anything in its service. Besides the flat spots caused by sliding, the heating of the wheel by application of the brakes is a fruitful cause of cracked brackets and plates. Brakeshoes should be made of cast-iron, not too hard, and without the introduction of devices intended to give longer service, such as the use of blocks of wrought-iron or steel or alternate chilled sections in the face of the shoe. Practice of this sort may do in freight service, but it is out of place in passenger equipment. The shoe should be machined to fit the wheel tread. It may be said that they will wear to fit the tread, but just what will happen and what kind of brake service will be obtained while the shoes are wearing to a fit is uncertain.

Again, shoes are made that bear on the outer part of the tread and point of flange, the center being cut out so that there is no contact with the part of wheel which runs on the rail. This is exceedingly dangerous. The brakeshoes must necessarily wear to a close fit on the flange and with grit and dust constantly working up between the two, serious chances for accident are taken. The heating of flange from this cause is very dangerous. On the opposite side, the drip from oil boxes keeps the outer edge of tread in such shape that proper friction can not be obtained.

The area of the face of the shoe should be as great as possible, as the life will be longer and it will not be necessary to take up the slack so often.

The election of officers resulted in the choice of the following: President, Eugene Chamberlain; Vice-President, F. B. Griffith; Secretary and Treasurer, S. W. Spear. The business session was followed by a banquet at which over 100 were present. At the next meeting the subjects considered will be "A Uniform Charge for Labor for Repairs made to Cars under Rules 6 and 8, Sections B. and C," and "Steel Trucks for Freight Cars."

COMING TECHNICAL MEETINGS.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Feb. 16, Baltimore, Md. Secy., R. W. Raymond, New York.
WESTERN RAILWAY CLUB.
Feb. 16, Rookery Building, Chicago. Secy., W. H. Marshall.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Feb. 16, Secy., J. H. Harlow, Pittsburg, Pa.
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Feb. 16, Secy., Ralph W. Pope, 12 W. 31st st., New York. "Proposed New System of Alternating Direct Current Transformation," F. J. Patten.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Feb. 17, Secy., S. E. Tinkham, City Hall.
ENGINEERS' CLUB OF ST. LOUIS.
Feb. 17, Secy., Arthur Thacher, Odd Fellows' Building.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Feb. 17, Secy., F. Collingwood, 127 East 23d St., New York. "Dikes in Holland," W. Starling.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Feb. 18, Secy., C. H. McLeod, Montreal, P. Q.
ENGINEERS' CLUB OF CINCINNATI.
Feb. 18 Secy., J. F. Wilson.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Feb. 18, Secy., T. G. Philfeldt, 113 Adams St.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Feb. 18, At Atlanta, Ga. Secy., F. A. Charlot, Macon, Ga.
NEW YORK RAILROAD CLUB.
Feb. 18, Secy., H. G. Prout, 73 Broadway.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Feb. 19, Union Station, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Feb. 20, Secy., F. D. Jones, Helena.
ENGINEERS' CLUB OF PHILADELPHIA.
Feb. 20, 1122 Girard St. Secy., J. C. Trautwine.
DENVER SOCIETY OF CIVIL ENGINEERS.
Feb. 23, Secy., Geo. H. Angell, Jacobson Block.
NATIONAL ELECTRIC LIGHT ASSOCIATION.
Feb. 23, 24, 25, at Buffalo, N. Y. Office, 18 Cortlandt St., New York.
QUARRY OWNERS NATIONAL ASSOCIATION.
Feb. 25. Chicago. Secy., B. A. McIlce, Bloomington, Ind.
WESTERN SOCIETY OF ENGINEERS.
March 2, Secy., J. W. Weston, 330 La Salle St., Chicago.
ENGINEERS' CLUB OF MINNEAPOLIS.
March 3, Public Library Bldg. Secy., F. W. Cappelen.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
March 4, Secy., E. K. Smoot, 305 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
March 4, Secy., O. von Geldern, 319 Market St., San Francisco.
SWEDISH ENGINEERS' CLUB.
March 5, Secy., P. Valentine, At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia.
NORTHWEST RAILROAD CLUB.
March 5, Union Station, St. Paul.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
March 7, Secy., C. L. Annan.
ATLANTA SOCIETY OF CIVIL ENGINEERS.
March 8, Secy., Parker N. Black, Capitol Block.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
March 8, Secy., A. R. Porter, 50 Euclid Ave.
NORTHWESTERN SOCIETY OF ENGINEERS.
March 8, Occidental Block, Seattle, Secy., E. H. Warner.
NEW ENGLAND RAILROAD CLUB.
March 9, United States Hotel, Boston. Secy., F. M. Curtis.
ENGINEERING ASSOCIATION OF THE SOUTHWEST.
March 10, Secy., O. H. Landreth, Nashville, Tenn.
TECHNICAL SOCIETY OF NEW YORK.
March 10, 194 Third Ave. "Boiler Plant."
ASSOCIATION OF ENGINEERS OF VIRGINIA.
March 12, at Roanoke. Secy., J. E. Schick, Roanoke, Va.
ENGINEERS' CLUB OF KANSAS CITY.
March 14, Baird Building. Secy., H. Goldmark.
WISCONSIN POLYTECHNIC CO.
March 14, Secy., E. F. Neukom, Milwaukee, Wis.
CENTRAL RAILWAY CLUB OF BUFFALO.
March 24. Secy., Jas. Macbeth.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
May 16 to 20, San Francisco, Cal. Secy., F. R. Hutton, 12 W. 31st St., New York.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

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D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST..... .....BUSINESS MANAGER

SUBSCRIPTION RATES: one year, $5.00; 6 months $2.50; 4 months, $2.00; single copies, 15 cents. To all foreign countries in the Postal Union, add $2.08 to above prices for postage. Subscribers can have the mailing address of their paper changed as often as they desire. Send both the old and the new addresses. No club rates allowed.

The date when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance. No other receipt is sent unless requested.

ADVERTISING RATES, 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Tuesday afternoon; new advertisements, Wednesday afternoon; transient advertisements, not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

Our attention has been called to the fact that we overlooked the Garabit viaduct in France, 406 ft. high, built by M. Eiffel, in stating that the Loa viaduct in Bolivia, 336½ ft. high, was the highest in the world, as we did in our last issue. The correction was pertinent. It will be a long time, we apprehend, before the height of the Garabit viaduct is exceeded.

The consumption of water per capita in any city is generally a difficult thing to determine, even with approximate accuracy, principally because the actual population supplied is not often known. The last report of Lieut.-Col. George H. Elliott, U. S. A., in charge of the Washington (D. C.) Aqueduct, gives some interesting figures on this subject. A plot of Washington and the former district of Georgetown was obtained from Capt. Jas. L. Lusk, of the district water office, showing block by block the actual areas supplied by the water-works. A careful estimate by the census bureau of the population in these areas showed the aggregate to be 187,000. The total "consumption and waste" for the year ending June 30, 1891, was 36,588,629 gallons, or 196 gallons per capita. Until recently the District of Columbia was divided into Washington and some outside districts, the largest district being Georgetown, and it only of the outside districts being supplied from the Washington Aqueduct. The whole district is now one in its minor government and is thus a municipality. Therefore in the article on "Consumption of Water and Uses of Meters," in our issue of Jan. 23, the total population of the District was used in Table S–S, as was the total population of other municipalities. Attention was called to the fact that the average daily consumptions per capita there given were based on the total population of the cities and not on the actual population supplied, thus making the figures too low. The above extracts from Col. Elliott's report enable us to show just how much too small the per capita consumption for one city, Washington, are. The total population of the District, and of the city of Washington, according to the list of "Fifty Principal Cities" in Census Bulletin No. 52, is 230,392. Using these figures, together with the average daily consumption given above, we have an apparent per capita consumption of 158 gallons, against an actual consumption of 196 gallons, the difference being 38 gallons, or about 20 per cent. too small.

The enormous consumption at Washington, more noteworthy because of the fact that the city is not a manufacturing center, is doubtless largely due to the unlimited available supply, and the fact that a gravity system is in use. But it is also due in great measure to the practical lack of meters, there having been but 98, or 0.3 per cent. of the total number of taps in use July 1, 1891. Col. Elliott well suggests that the meter system be extended and that such a course would "tend to postpone the need of raising the dam at Great Falls for the purpose of increasing the supply from the Potomac to the conduit, the early necessity of which" is mentioned in the report already referred to. Undoubtedly the use of meters would tend to postpone the need for this and other expenditures, and it is surprising that this was not seen and acted upon before the consumption reached its present height.

Apropos of what we said last week as to letting our river and harbor works by contract for a gross sum, contingent on the success of the work, the practice of the Navy Department for many years past in advertising for bids has been to ask for them (1) on the Department's plans for hull and machinery; (2) on the bidder's plans for hull and machinery; (3) on the bidder's plans for hulls and the Department's plans for machinery, or vice versa. This plan cannot but have attracted our readers' attention, and we think cannot have failed to strike them, as it has struck us, as an eminently sensible one; at once relieving the Department from that feeling of helpless dependence on bidders which would result if it had no plans of its own, and insuring that it shall have better plans than its own if better can be had, thus doing away with all danger of fossilization in its own designing department.

Now with certain provisions as to details which we will not stop to elaborate, why may not this plan of the Navy Department be applied with slight modification to our river and harbor work? To take a prominent example, merely as an example, and without assuming that details of which we know nothing may not make it a quite unsuitable example: It is now desired to deepen the New York Harbor entrance to 30 ft. and permanently secure that depth. There are at least two civil engineers of standing known to us who think this can be effected more simply and cheaply then by the War Department's plants. They are entitled to be heard on equal terms. Before proceeding with the work on any plan, or any other like work, why should it not be required to advertise it in some such form as this?

> Proposals are invited for deepening the outer channel of New York harbor to 30 ft. at low tide and permanently securing said depths. Bids will be received either (A) on the plans and specifications of the Chief of Engineers, or (B) on the bidder's plans and specifications. Under either (A) or (B) bids will be received either per cubic yard or other unit of quantity, or in gross for the entire work guaranteeing its efficiency and success for years. Under the law, preference will be given to bids for a gross sum, guaranteeing the efficiency of the work, unless in the opinion of the Chief of Engineers the amounts thus bid are unreasonably high, and public interest will be better served by rejecting such bids, which opinion, and the reasons therefor, will be announced at the time of awarding the contract.

Why do not some of the zealous friends of the civil engineer who see so much of evil in existing conditions, as we do also, fight for something like this? We should then be putting the management of our public works on something like a rational and defensible basis. We should retain the Corps of Engineers in supervisory control over these works, while at the same time we should practically insure that the design of every work which the corps had not designed to the best advantage would pass out of their control under conditions which would not tend to create antagonisms, but on the contrary lead to the same cordial co-operation which exists between the Navy Department and naval contractor. Why should it not? The army engineers are but men. They do not love a heavy burden of personal responsibility for its own sake. When they prepare plans for improving a harbor they will very naturally oppose those who ask Congress, in effect, to take sides against them, and declare them incompetent and untrustworthy by taking the work away from them.

But if by general provision of law, Congress should say that plans for every large work were to be first prepared, and then bids invited in some form like the above, with a preference to those who would take the entire responsibility for results on their own plans or any others, why should not the army engineers welcome this change? We fully believe they would welcome it. It would be fair and equitable. It would cast no reflections on them. They know too well that in hydraulics "doubtful things are mighty uncertain," to feel aggrieved if a bidder preferred some plan of his own to theirs. They would have the further inducement for doing so that they, like others, would be compelled to make themselves responsible for accomplishing certain specific results for a certain sum if they rejected bids on the ground that they were excessive. On the other hand, it would be their duty to reject such bids if they believed the bid excessive, even if, in some cases, their judgment should prove fallible, and thus the government would be protected from having to make excessive payments.

Under these conditions, civil engineers would have all the chance which they could ask, and more, too. Every young civil assistant could feel that he was acquiring an experience which he could turn to good account later, if he had the capacity, and that he had the strongest possible inducements to make a constant and careful study of hydraulic problems. The practical result would be that a large proportion of the works, perhaps two-thirds, would be carried out under civil management, but that all of them would be supervised by the Corps of Engineers acting as "watch dogs of the Treasury" and guardians of the public interest. Nobody could be better suited for this function, especially as their own professional skill and judgment would increase under this plan. At every letting they would in effect have a judgment of the whole engineering world upon their plans, and as each work progressed, they would have a chance to see whether or not their original opinions had been sound

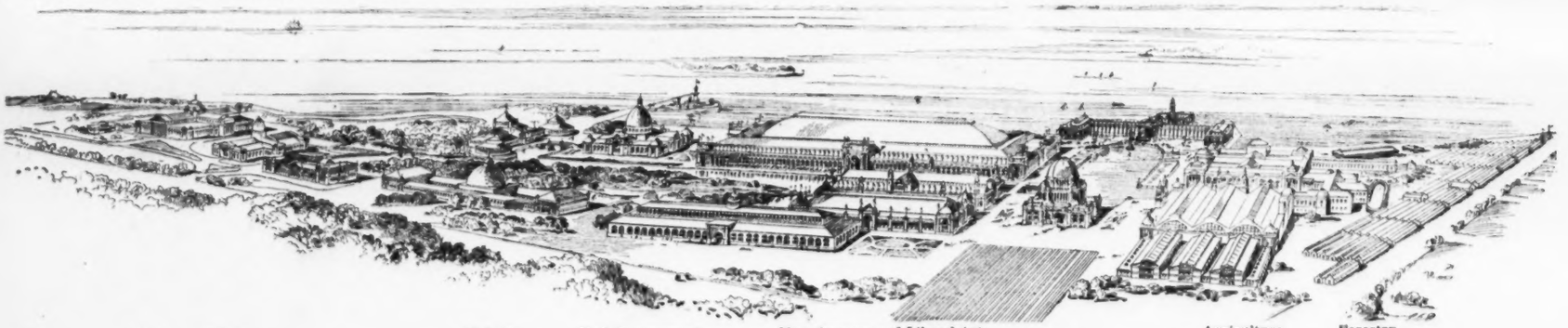
When we see a movement started for some rational reform of this kind, we can promise to all civil engineers that they will find the influence of this journal thrown steadily and zealously in its favor. But we are frank to say that we take little interest in mere agitation to put A out and B in, unaccompanied by any change of method. So far, that is all the agitation has amounted to.

An important step in the right direction has just been taken by the City Council of Plainfield, N. J., toward securing a street railway system in accordance with the interests of the people instead of allowing some company to work through the Council a franchise primarily or wholly in the interest of its stockholders. This step is in the nature of a resolution to the effect that as the city needs a street railway, proposals be asked from parties who shall offer to organize a company under the State laws, the proposals to "specify in detail the route or routes proposed, the character and description of motive power, rails, street cars and other equipment, and the terms and advantages offered." (Other terms are given in our advertising columns It will be noticed that the Council proposes to see that the railway is properly located, and that a satisfactory motive power and equipment are adopted; also that it seems to assume that the franchise is worth something since it asks bidders to state the "advantages offered."

It is important to note that the Council has itself taken the initiative, and by widely advertising the opportunity which is here open for the investment of capital secures the most extended competition and increases the chances for satisfactory proposals.

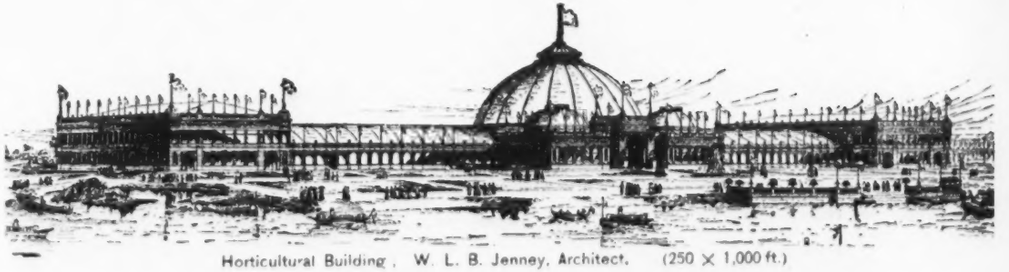
If, now, the Council secures proper engineering advice and contracts with honest and capable parties for the organization of a company and the building and operating of the road, all of which it will doubtless do, a good street railway system seems assured. If, in addition, the Council receives and accepts an offer establishing a minimum fare, and providing that the company shall pay the city a percentage of its gross receipts for the privilege of using the public streets for profit, the city will not only have a good street railway system, but will also receive a revenue from it which will increase the public improvement fund or reduce the rate of taxation, or both. If, still further, the length of the franchise is limited to a reasonable period, the city may, on its expiration, secure still better terms as regards rates of fare, revenue from the company, and general character of the road which shall be in accordance with the changes of these years of rapid improvements; and if the franchise is properly drawn, at regular intervals the city may buy the railway at a price to be determined by arbitration.

It is interesting to note that the present Council



BIRDS-EYE VIEW.

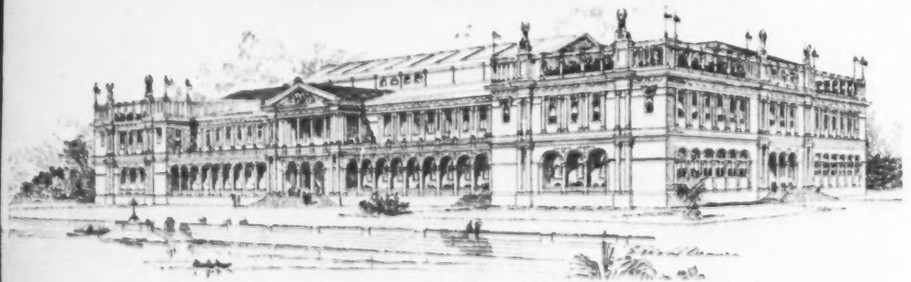
Fisheries Building: Henry Ives Cobb, Architect (363 × 163 ft.)



Horticultural Building, W. L. B. Jenney, Architect. (250 × 1,000 ft.)

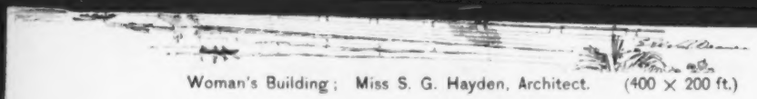
Fine Arts Building, C. B. Atwood, Architect (320 × 500 ft.)

Agricultural Building, McKim, Mead & White, Architects. (800 × 500 ft.)

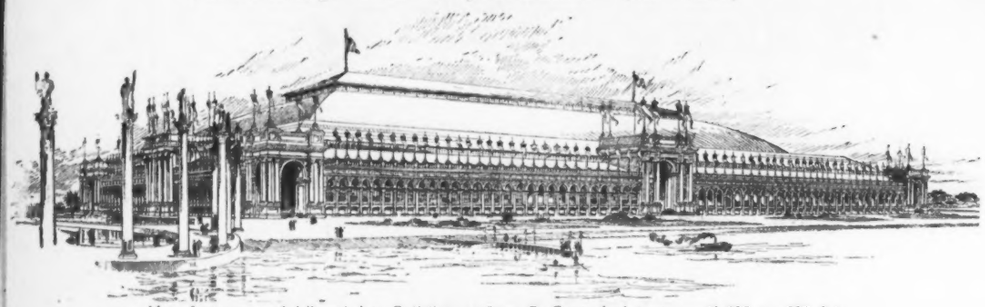


Woman's Building; Miss S. G. Hayden, Architect. (400 × 200 ft.)

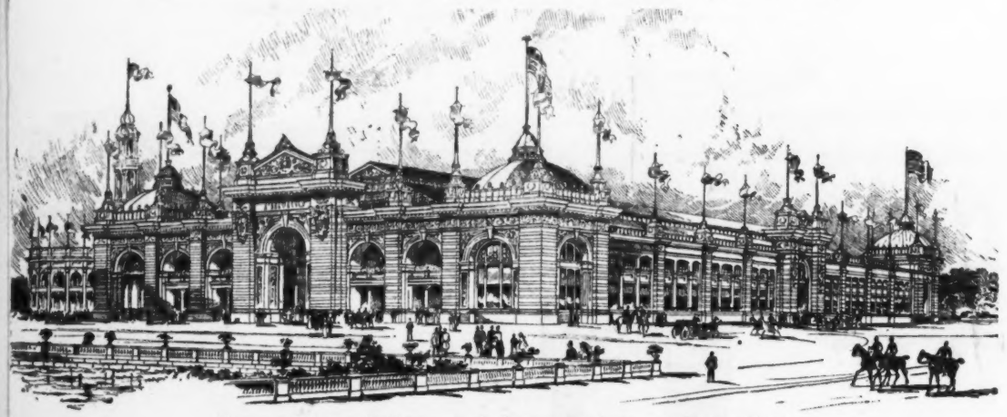
Transportation Building; Adler & Sullivan, Architects. (960 × 250 ft.)



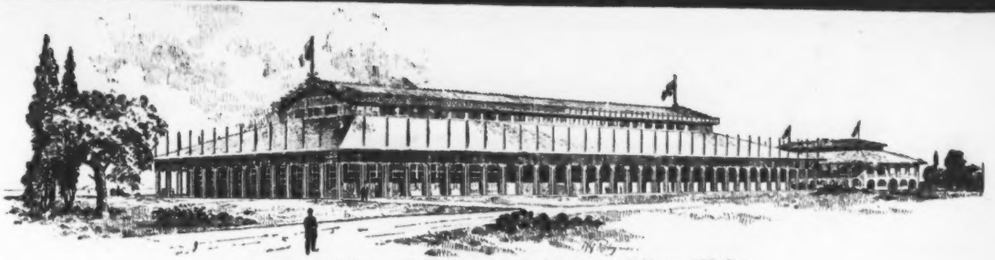
Woman's Building; Miss S. G. Hayden, Architect. (400 × 200 ft.)



Manufactures and Liberal Arts Building; Geo. B. Post, Architect. (1,687 × 787 ft.)

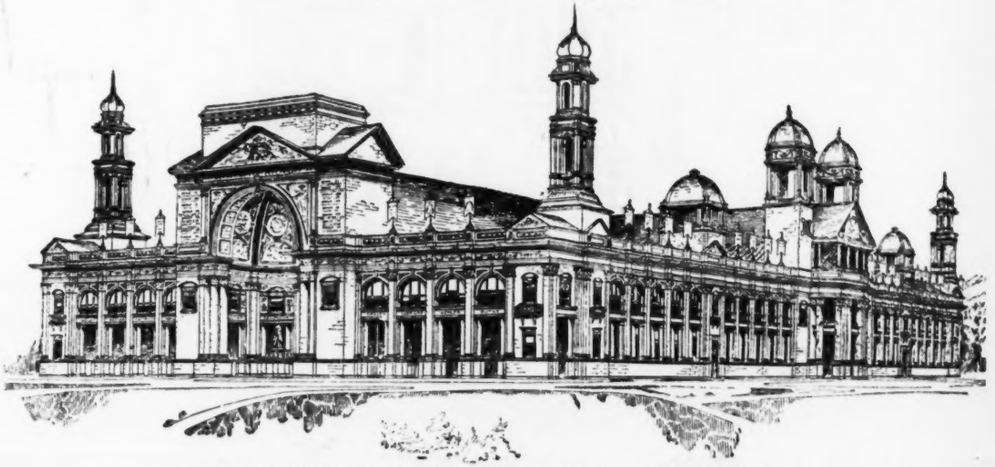


Mines and Mining Building; S. S. Beman, Architect. (700 × 350 ft.)



Forestry Building; C. B. Atwood, Architect. (200 × 500 ft.)

Dairy Building; C. B. Atwood, Architect. (95 × 200 ft.)



Electrical Building; Van Brunt & Howe, Architects. (345 × 700 ft.)

United States Government Building; J. H. Windrim and W. J. Edbrooke, Architects. (420 × 350 ft.)

Machinery Building; Peabody & Stearns, Architects. (800 × 500 ft.)

Administration Building; R. M. Hunt, Architect. (260 × 260 ft.)

THE MAIN BUILDINGS FOR THE WORLD'S COLUMBIAN EXPOSITION AT CHICAGO, 1893.

succeeds one which, by means of a "combine" of six out of the ten members, granted a street railway franchise of so doubtful character that through the intervention of the courts it was repealed. The same Council granted water-works and sewerage franchises which are being rescinded by the present Council as rapidly as possible. The doings of the old "combine" or "Big Six," have already been commented upon at some length in these columns. They were of such a character and met with such opposition that at the recent election the members of the "combine" were defeated by a vote of two to one.

The apparent collapse of the steel beam trust, if it proves to be permanent, is a fortunate event, not only to consumers but to the protective principle itself, as its practical working on this point has been very unfair heretofore, and done much to create prejudice. Steel beams are now used on an immense scale, which bids fair to soon outdo the rail industry itself, in all forms of city buildings. Their natural price at the present time, when the demand has become prodigious, is not greatly different from that of rails, and prices abroad actually are about on an equality. But at home, owing partly to a marked difference in tariff rate, and partly to another still more important cause, there has long been a very great difference in price. This difference would have been quite sufficient to tempt extensive importations except for (1) differences of sections, and (2) above all, the practical inconveniences of changing, increasing or decreasing orders during the progress of the building, if beams were ordered from abroad, which has greatly discouraged all attempts at importations. Hence for the last two or three years the combination price for steel beams has been maintained at about $69.44 (3.1 cts. per lb.) against $30 per ton for rails, the duties being $28 and $20.16 per ton respectively. Under the new tariff act, the duty on beams has been reduced to $20.16 per ton against $13.44 for rails, but still, during the year ending June 30, 1891, * the duty was 66% on the valuation of imported beams, against only 35¼% on the valuation of rails.

It is now reported that prices of 2⅛ cts. ($56 per ton) will be the maximum, and that the price may go down to $44.80 or even lower, and still leave the larger and better equipped rolling mills a fair manufacturers' profit, though the poorer ones may not be able to run at these figures. If so, it will give an immense stimulus to building operations of all kinds.

The amendments to the patent law recommended by Commissioner Simonds in his annual report, which we abstract in another column, are so manifestly proper and some of them are so urgently needed that some means ought to be taken to bring Congress to a realizing sense of their importance. Doubtless other and more radical reforms are needed in the patent system; but the pressing need at present is that the abuses of the system, such as keeping applications pending for many years in order to prolong the life of a patent, should be reformed. It is these abuses which bring the whole patent granting system into ill repute with the general public, and they have caused Congress, which reflects public sentiment, to neglect the Patent Office and make it practically impossible for it to carry on its work in a proper manner. The most important amendments proposed by the Commissioner are simply that an applicant must take action upon his application at least once in six months, instead of once in two years, as at present, and that no patent shall live for more than 20 years from the date of the original application.

While there is some tendency among engineers at the present day to look with disfavor on the patent system, there is really no class which is more interested in its maintenance, and in the introduction of needed reforms. This is especially true of mechanical engineers and electrical engineers; but the number of members of the Civil and the Mining Engineers' societies, whose names appear at some time or other in the pages of the "Official Gazette" is exceedingly large.

This being the case, it would be altogether proper for action on this matter to be taken by the various engineering societies, with a view to urging Congress to the adoption of the amendments recommended by the Commissioner. Many of the organizations of manufacturers, representing industries whose development is largely due to the patent system, might also take action on this matter with much propriety. The probabilities are that unless those who are interested and informed on this matter will take pains to further the reform, Congress will pay as little attention to the recommendations of Commissioner Simonds as it has to the recommendations of former Commissioners.

* When the duties were somewhat mixed, however, the new tariff having gone into effect during the fiscal year.

RAILWAY ACCIDENTS TO PERSONS.

Some 18 months ago (June 7, 1891), on the appearance of the second annual Interstate Commerce statistical report, we gave the first approximately accurate comparison ever made between the railway accidents of Great Britain and the United States. The U. S. statistics were only in total, and the imperfections in many minor details were those natural to a first attempt, but they had much interest and value as the first approach to accurate statement ever made.

A year before (Aug. 24, 1889), when the first report appeared, we made a similar but far less elaborate analysis, having the same merits and demerits.

To-day it is for the first time possible to make a close approach to an accurate and trustworthy comparison of these different sections of the United States with each other, and with foreign countries and single states.

Below will be found such a comparison. It appears to us to have extreme interest. It is certainly the first of its kind, and it has been compiled with great care. It shows for (1) the Northern United States east of Chicago (14 States); (2) Southern United States east of the Mississippi (10 States), and (3) Western United States (all other States and Territories), as also for (4) Great Britain, (5) Germany, (6) New York State and (7) Massachusetts, the total number of persons killed or injured from each of 10 to 15 different causes of casualty, and also the numbers of passengers, employees and "others" killed or injured from each cause.

We cannot possibly give all this in one issue. We shall not attempt to give it in one or more big tables, for each to pick out the information by himself. The reader would be merely discouraged, and be likely to overlook important points. But by taking up the vast mass of figures point by point, it will be possible to see clearly and at once how the railway administration of these several groups, states, and countries compares in its risks to passengers, to employees, to trespassers, etc.; and how serious the comparative risks are from collisions, derailments, coupling cars, station casualties, and other like causes.

The following are the data used, with some remarks and explanations:

The three great U. S. groups of the interstate commerce statistical report as printed, are shown in the little map published in our issue of Jan. 30. They are extremely well chosen for the purpose. A line from Chicago down the Illinois-Indiana State line and thence down the Mississippi to its mouth cuts off a vast western area (hereinafter called the "Western U. S.") in which the operating conditions are still tolerably uniform and markedly different from the Eastern region. Though this western division includes over 75 per cent. of the total area of the United States, it has not much over half the railway mileage, and only 39 per cent. of the train mileage.

The Ohio and Potomac rivers subdivide the eastern area into two groups, the smaller one (hereinafter called the "Northeastern U. S." group), the seat of very intense railway activity, and the other (the "Southeastern U. S." group) of a shade less activity than even the Western group. We have abstracted a few main facts in regard to these groups, in comparison with New York, Massachusetts, Great Britain and Germany in the following table:

	No. U. S.	So. U. S.	W. U. S.	N. Y.	Mass.	Gt. Britain.	Germany
Area, sq. m., 000 omitted.	309.3*	489.2*	2901.5*	47.6	8.0	120.5	211.1
Population, 000 omitted..	26,801*	14,914*	20,850*	5,998	2,239	37,740	49,421
Miles r'y.....	47,210	27,667	88,720	7,661	3,210	20,073	28,555†
Pop. per sq. m.....	87	30¼	8	126	278	313‡	233
Pop. per mile ry.....	569	540	235	783	698	1,878	1,734

* The areas and populations given for the U. S. sections do not quite aggregate the proper U. S. totals, on account of Indian Territory, etc. Neither are they otherwise quite precise, as we did not subdivide some State areas, etc.

† Including 4,888 miles of secondary (narrow gage) mileage, not included in the other statistics following.

‡ England only, 543 per sq. mile. For many reasons it would be desirable to subdivide the British railway and other statistics between England, Scotland and Ireland, as they differ considerably among themselves in conditions and results. But it would have involved too much detail.

It will be seen that the Northern U. S. railways ought to be held up to a higher standard of safety than the other two groups, since they have a much denser population to support.

The interstate statistician's records of casualties to persons is now in very good form. Most of the errors of substance on which we have had to comment in former years, such as confusing accidents to persons from trains with accidents to trains have been corrected. We shall find, however, that the reports still have two serious defects, necessarily resulting in errors. The first is that the classification is not sufficiently detailed, some of the very frequent causes of accident, as, for instance, "walking or being on track" or "getting on or off trains in motion" having no place whatever in the reports. As a consequence the line for "other causes," coming after a list of eight specified causes, has by far the largest totals of any, and covers from half to two-thirds of the total casualties reported! This is quite absurd, and shows that the form demands revision and expansion. The casualties lumped together as "other" in such a return should aggregate but a small percentage if the classification were adequate. We fear, however, that the large aggregate of "others" in part results from the following less easily curable difficulty.

The comparative analysis of the records which is to follow will clearly indicate that there is still a considerable residuum of misclassification of casualties in the statistician's report. We do not think the fault lies in that office, but in the original filling out of the reports to that office.

If so, the difficulty can never be completely overcome, so long as it is left to some clerk on each railway to fill out a return of casualties once a year to the commission. With the best intentions some of them will do this stupidly. The only method by which uniformity of classification can be obtained is by doing the work in one office from reports of each individual casualty. For many reasons the sooner we have this the better, both as respects accidents to persons and accidents to trains. The latter has never yet been compiled or published. Not one in 50, perhaps not one in 100 of them, is ever heard of outside of those immediately concerned and of some clerk in the general office. No damage is done by them to person or property, beyond a few minutes' delay, but every one of them threatens danger, and it would powerfully conduce to good railroading and to the introduction of improved appliances if the real facts about them could be correctly published without note or comment. Neither would there be any serious opposition. The Philadelphia & Reading Railroad published a full table of them, voluntarily, for many years, as a matter of record.

With all these minor defects, however, the accident records of this year's interstate report give us details of the main facts desired in regard to three great geographical groups separately. Each of them is an empire in itself, and we shall treat them as such, not complicating our tables by any totals or averages for the United States as a whole.

The New York State report is still better suited for our purpose. There appears in it every year a single-page table in which is given the number of both killed and injured for passengers, employees and other persons separately, for each one of some 31 different causes of casualty, including nine different kinds of collisions, eight kinds of derailments, locomotive explosions, walking on track, catching foot in frog, putting arms out of windows, and various others, in addition to the nine classes used in the interstate reports, and below appearing. The table is quite a model in its way, permanently classifying all the facts of record in such detail that any desired part of them can be abstracted at any time in the future for any particular use. As such the table is well worthy of being copied verbatim into the reports of other States, or of the interstate commerce commission. Its one serious omission seems to be

the lack of any list of injuries at stations, which is, perhaps, intentional, it being considered sufficiently definite to include such cases with others of "walking or being on track."

The same can by no means be said for the Massachusetts State reports. To our amazement, we find that the Massachusetts accident records, though given in much detail every year, are given in such imperfect form that it is all but impossible to make any use of any part of them for a comparative statistical analysis. Such fundamental facts as the number of passengers killed or injured by train accidents are not recorded and are not deducible by any ingenuity from the eight or ten pages of alleged statistics. Still less is it possible to determine how many were killed or injured by specific kinds of accidents, like collisions. The number of passengers killed and injured from all causes is given, but this includes dozens of possible causes; and the number of persons of all kinds killed in three different classes of train accidents is also given, but giving these cross-totals does not give the original figures of which it is made up.

To illustrate some of the absurdities of the Massachusetts form of report more completely, and at the same time explain how four totals which we shall need to use, and shall use below, were obtained, there will be found in each yearly volume for a great many years back five successive columns under the general head of "Trespassers" headed: (1) "Walking or lying on track;" (2) "Unlawfully riding on cars;" (3) "Fatal;" (4) "Not fatal;" (5) "Suicides." The sum of the first column is the same as that of the second two. That is to say, we have given in the four columns noted the four totals only of the following little table, but not the four primary quantities of which these four tables are made up, which could obviously have been given in the same space. Had they been given, any one who pleased could then have obtained the four totals also, by the simple expedient of adding two primaries together, but the reverse is by no means true. Having use for the primary facts, but not for the totals, we have had to guess at them, as shown by the numbers in parentheses, so guessing at each as to preserve all four of the known totals.

	Killed.	Injured.	Total.
Walking, etc., on track....	(448)	(240)	688
Trespassing on cars.....	(80)	(93)	173
Total killed.....	528	Injured, 333	

It is easy to guess how these defects of form originated; from a desire to make the main facts (or what seemed such 20 years ago) easily grasped and impressive. This is especially conspicuous in the continual grouping together in one total of killed and injured; but such grouping of incongruous things never should be done if the object be merely to state truth. "Killed" means a definite and grave thing. "Injured" may mean anything or nothing. How completely injuries are reported depends far more on the vigilance of the inspecting body than on the facts, so that it is continually necessary for the careful student to consider the comparative ratios of killed to injured before giving any weight to comparisons of injuries. It would be as rational and as defensible to add the totals of the scared to swell the numbers of the injured as to add the numbers of the injured to swell the numbers of the dead. Some of the scared are really more injured and suffer more than those with bodily hurts.

The Massachusetts Commission, therefore, would do well to abolish altogether this totaling of incongruous things, and otherwise reconstruct their present tabular forms; but if it does not see its way to this, and will simply add a one-page table constructed on the "multum in parvo" principle, modeled in form and substance on the New York table referred to, or for form on that on page 17 of their last report, they will be rendering their State and the public a real service. That it is a needed service will very clearly appear from our next following issues.

The British accident to persons records are quite models in their way. It will be a long time before we see the like in this country, if we ever do. Our railway system seems too big to permit of it. And yet these blue books are not very large, some 130 quarto pages, which includes the detail reports upon accidents investigated by officers of the Royal Engineers on behalf of the Board of Trade. They give separate returns for every railway, and the minuteness of the classification can be judged from the fact that accidents to persons from coupling cars are classified under no less than eight different heads.* Yet, withal, they are not cumbersome, and the classification is so systematic that any desired facts are readily abstracted from them, with either much or little detail.

The German railway statistics are compiled with at least equal care and completeness, but the operating conditions in Germany are so dissimilar from our own that it would not be worth while to attempt much comparison of detail. We find an abstract of the main results as to accidents to persons in a report by Prof. A. Goering, of the Berlin Royal Polytechnic School, to the Massachusetts Railroad Commission.†

This covers the fiscal year 1887. For Great Britain we take the report for the fiscal year 1890, which was a fair average year, with no exceptional great disaster in it, though with rather more than the usual aggregate of small casualties. The same is in substance true for the insterstate report year (ending June 30, 1890) of all three of the great United States groups.

For the State of New York we take the aggregate of the two years 1890-91, thus obtaining a total of traffic which is fairly comparable with either of the other great groups, for New York has nearly one-sixth of the train mileage of the entire Union. Similarly, we take the aggregate of the Massachusetts reports for five years, 1885-89.‡ This gives us a volume of traffic about twice as great as that of the whole South in one year, and sufficiently great to make it properly comparable with the rest.

	No. U. S. 1890.	So. U. S. 1890.	W. U. S. 1890.	N. Y. 1890-91.	Mass. 1885-89.	Gt. Br't'n. 1890.	Germ'y. 1887.
Miles railway.....	47,210	27,667	88,720	14,962	11,661	20,073	23,667
No. locomotive.....	15,039	3,310	11,579	9,200	7,437	16,237	.....
No. employees.....	374,628	94,054	280,619	136,576	164,973	346,426	.....
Train miles, '000 omitted.	Passenger.....	147,107	31,916	106,551	93,917	87,422	166,667	.....
	Freight.....	206,008	52,654	176,506	175,253	66,060	143,625	.....
	Total	353,115	84,570	283,057	229,170	153,482	310,292	154,255
Passenger miles, '000,000 omitted.....		6,679	1,117	4,051	4,929	5,718	5,888	5,202
Ton miles, '000,000 omitted.....		42,677	7,707	25,823	28,891	7,091	10,609	.....
Per cent. of trains.	Passenger.....	41.7%	37.8%	37.9%	41.1%	57.0%	53.9%	.....
	Freight.....	58.3%	62.2%	62.1%	58.9%	43.0%	46.1%	.....
Trains per day both ways.	Passenger.....	8.6	3.2	3.3	17.2	20.6	22.7	.....
	Freight.....	12.0	5.2	5.5	24.7	15.5	19.6	.....
	Total.....	20.6	8.4	8.8	41.9	36.1	42.3	18.0
Train miles per locomotive.....		23,500	25,550	24,450	24,940	20,650	19,130	.....
Train miles per employee.....		945	899	1,012	1,680	932	871	.....
Av. train load.	Passengers.....	45.4	35.0	37.9	52.5	65.5	35.3	.....
	Freight, tons.....	207	147	146	214	107	74	.....
Av. passenger journey, miles.....		18.7	36.9	38.8	20.2	14.9	7.2	17.6
Proportion double track..		½	Little.	Little.	¼	⅛	⅛	.....

NOTE.—About 250,000,000 elevated railway passengers, making an average journey of perhaps three miles, or 750,000,000 passenger miles, are not included with the passenger statistics for the Northern United States, though the same class of London travel is included with the British statistics. As this class of business is carried in both countries with hardly any accidents to trains or persons, the difference is of some moment. When it is attempted to compare casualties per passenger carried, regardless of haul (which we shall not do, though it is the common British method) the difference is one of extreme moment, as the omitted elevated railway records would nearly double the number of passenger trips in the Northern United States, while they would add hardly anything to the total of casualties.

The table herewith gives in the same order as the preceding table, and as will be used in the following statistics, the main units of railway traffic which we shall use in analyzing the records of casualty, or which it may be desirable to refer to as a matter of general information. We are now ready to proceed with the accident records, but will postpone doing so until our next issue.

*A fact which sometimes leads to understatements of the total number of British coupling casualties, from not looking beyond one or two of these items. Copies of these reports entitled "Railway Accidents: Returns of Accidents and Casualties as reported to the Board of Trade," etc. Can be obtained from Messrs. Eyre & Spottiswoode, East Harding St., Fleet St., E. C., London. Price 1s. 1d.

†January, 1889, Rept., Appendix A.

‡The year 1889 was omitted by an accident from our first tabulation, and the difference of one year was not deemed of importance enough to demand revision of the tables.

Condensing steam engines, where water is scarce, can be arranged to use the same condensing water over and over, provided suitable provision is made for cooling. On the Pacific coast, where dear coal makes fuel economy of great importance, several recently erected steam plants have been arranged to cool the condensing water, and use it over and over. A writer in the last number of "Power" describes a typical plant of this sort, that of the California Street Railway Co., of San Francisco. On the roof of the building is placed a series of shallow tanks or pans with a total surface area of 8,000 sq. ft. They are in three tiers, and the water from the circulating pump is delivered into the upper one. The pans are set with a slight inclination and the water slowly flows in a thin sheet from one pan to the next and finally reaches the supply pipe, being cooled in the meantime from an average temperature of 140° F. to 80°. The total consumption of water by the plant, due to loss by evaporation, leakage, etc., is said to be about half what it is with the engine working non-condensing. That evaporation is the principal cause of the shrinkage is attested by the fact that the water cools much faster in a warm windy day than in a cool and still one. The average indicated horse power of the engine is 325. The vacuum obtained is 22 to 23 ins. The oil from the engine cylinders gives some trouble, as it collects on the surface of the pans, and has to be scrubbed off about once a month. A plain mesh of wire gauze used as a strainer and placed in the last tier of pans has proved a fairly efficient device for catching the oil. About 15,000 gallons of water or about enough for 14 hours consumption running non-condensing is the amount required to fill the circulating apparatus. It is apparent from this that the lack of an abundant water supply need not prevent the use of a condensing engine, provided the gain by condensing is worth a little extra trouble and expense.

The Society of German Railway Directors (Verein Deutscher Eisenbahnverwaltungen), at the close of last year, embraced 41 German, 21 Austro-Hungarian, 4 Dutch, 3 Belgian, 1 Luxemburgian, 1 Roumanian and 1 Russo-Polish "railway direction," 72 in all, representing a total length of track of 46,901 miles, against 46,102 in the year before. Of the increase, 799 miles of track 70% belongs to Austro-Hungarian and 30% to German "railway directions."

A Harlem River railway bridge bill is before the New York Legislature, in which the New York Central and the New York & New Haven railways ask for authority to construct a new bridge across the Harlem at Fourth Ave. The bridge would be 20 ft. above high tide, and would much reduce the vexatious delays in travel caused by the present low bridge.

A new water-pipe has lately been tested in San Francisco. The inventor is Mr. Speed, who makes the pipe of a mixture 40% of bituminous rock and 60% sand. The cost is said to be very low. The 4-in. pipe tested weighed 4 lbs. to the lin. ft. and though just made it only burst under a hydraulic pressure of 170 lbs. per sq. in. With a sheet iron casing, coated with asphalt varnish, the bursting pressure is said to be 500 lbs. per sq. in. The joint is made by simply using hot asphalt and then binding with a cloth. The pipe has been made up to 12 ins. diameter at the Byran Jackson works, where the test was made.

The Paris exposition of 1889 had a net balance of $2,000,000, according to figures recently published. The receipts consisted of admission fees, payments for space and concessions, the sale of materials after the close of the exhibition, and the subsidies from the city and the state. There were 125 concessions for cafés, restaurants, etc., the payments for which amounted to about $450,000, while nearly $45,000 were received for concerts, for the use of water and gas, etc. The total receipts amounted to about $10,000,000; or $1,400,000 more then the original estimate. The expenses amounted to $8,000,000, while the estimate was $9,300,000, and the profit therefore was about $2,000,000, as stated above. The receipts of the Paris exhibition of 1867 were about $5,250,000, and the expenses about $4,684,000, leaving a profit of $566,000. The receipts of the Paris exhibition of 1878 were about $4,635,000, including a subsidy of $1,240,000 from the city, and the expenses were about $11,080,000, including $2,800,000 spent on the Palace of the Trocadero. There was therefore a deficit of about $6,445,000, but the state gave no subsidy to that exposition, while the state subsidy was $1,200,000 in 1867, and $3,400,000 in 1889. Plans and particulars of these and other international exhibitions were given in our issue of Jan. 30,

LETTERS TO THE EDITOR.

LIGHTNING MULTIPLICATION.

Sir: If Mr. Wm. B. Fuller, who in your issue of Jan. 30 describes a new method of quick multiplication, will refer to a little book entitled "Lightning Method of Calculations," by B. F. Betts, and published by Warren Johnson & Co., Buffalo, N. Y., in 1870 (22 years ago), he will find his system beautifully described on page 24.

Yours truly, Chas. H. Tutton.

Buffalo, Feb. 6, 1892.

THE POPULATION OF TORONTO.

Sir: In your article on "Ownership of American Waterworks," Jan. 23, 1892, you give the population of Toronto in 1891 as 144,028. This is a mistake, as the third census (1891) gives the population as 181,220. Toronto.

Cote au Landing, Que., Feb. 1, 1892.

A QUERY AS TO PAVEMENT MEASUREMENTS.

Sir: I should be glad if you will allow me to ask members of the profession, through your columns, what has been their practice in paying contractors for paving between and outside the tracks of street railways, etc. Do they allow for the space occupied by the rails, or not? The question recently came up here, and has been settled as far as this particular case is concerned, in which the rails were the Johnson girder rails and patent chair, by the company paying for the space, allowing the measurement "out to out" of paving. Yours truly.

Topeka, Kans., Feb. 5, 1892. M. Am. Soc. C. E.

FLUME AND DITCH DIAGRAM.

Sir: I herewith inclose a diagram for computing grades and velocities of flow in flumes and ditches. The diagram scarcely needs any other explanation than is given on the diagram itself. It will be observed that with any two of the three factors, mean radii, fall and velocity, the third can be at once taken from the diagram direct. I have found it of very great assistance to me in the saving of much tedious calculation in the designing of proper cross-sections. If it is desired to use other values of "n" than the one on which the diagram is computed, the necessary correction can readily be made by adding or subtracting the proper percentage from the results obtained.

Yours truly. A. L. Adams,

Pendleton, Ore., Jan. 6, 1892.

THE HIGHEST TELEPHONE LINE.

Sir: In your issue of Dec. 5, 1891, there is an item about the height of the telephone line between Manitou and Pike's Peak.

There is one here in operation that crosses the summit of the Andes at an elevation of about 16,500 ft. above the sea level.

The stations are:

	Feet.
Chicla, elevation	12,220
Autarangra, elevation	15,256
Galera (west end), elevation	15,600
Galera (east end), elevation	15,680
Viscas, elevation	15,080

An engine is working at the western end of Galera Tunnel engaged in hauling out the excavated material; so that it is probable that the highest points at which a telephone line is in operation and a locomotive is working at present are in Peru. Jas. R. Maxwell,

Chicla, Peru., Jan. 16, 1892.

NOTES AND QUERIES.

J. W. inquires where information can be had as to burning clay for railway ballast. It will be found most completely in Mr. E. E. Russell Tratman's paper on "Railway and Street Railway Track" (Trans. Am. Soc. C. E., March, 1890), and in various back issues of this journal.

J. C., Gainesville, Fla., suggests the following substitute for a stand-pipe and says that he understands that waterworks have been constructed on this principle: Instead of a stand-pipe 120 ft. high and 20 ft. in diameter, place in a horizontal position an airtight cylinder of the same dimensions provided with a dome for air on top. Connect this dome with an air pump; or, when the pressure is too low, let the water run down in the cylinder and then pump until the required pressure is secured—in this case about 60 lbs. We have never heard of water-works so controlled and the substitute would undoubtedly be more costly than the stand-pipe to construct, as the horizontal cylinder would have to be much stronger to resist the pressure. There would be also all the trouble incident to the absorption of the air under pressure by the water. An elevated tank would be better than either the vertical or horizontal stand-pipe for keeping the distribution system under pressure. Air-vessels are often used to absorb the pump-shock when pumping direct into long lines of main. These are closed cylinders about 6 ft. in diameter and 30 ft. high, placed vertically. While similar in some respects to the arrangement proposed by our correspondent they do not perform the duty of a stand-pipe proper as they act only when the pumps are in motion.

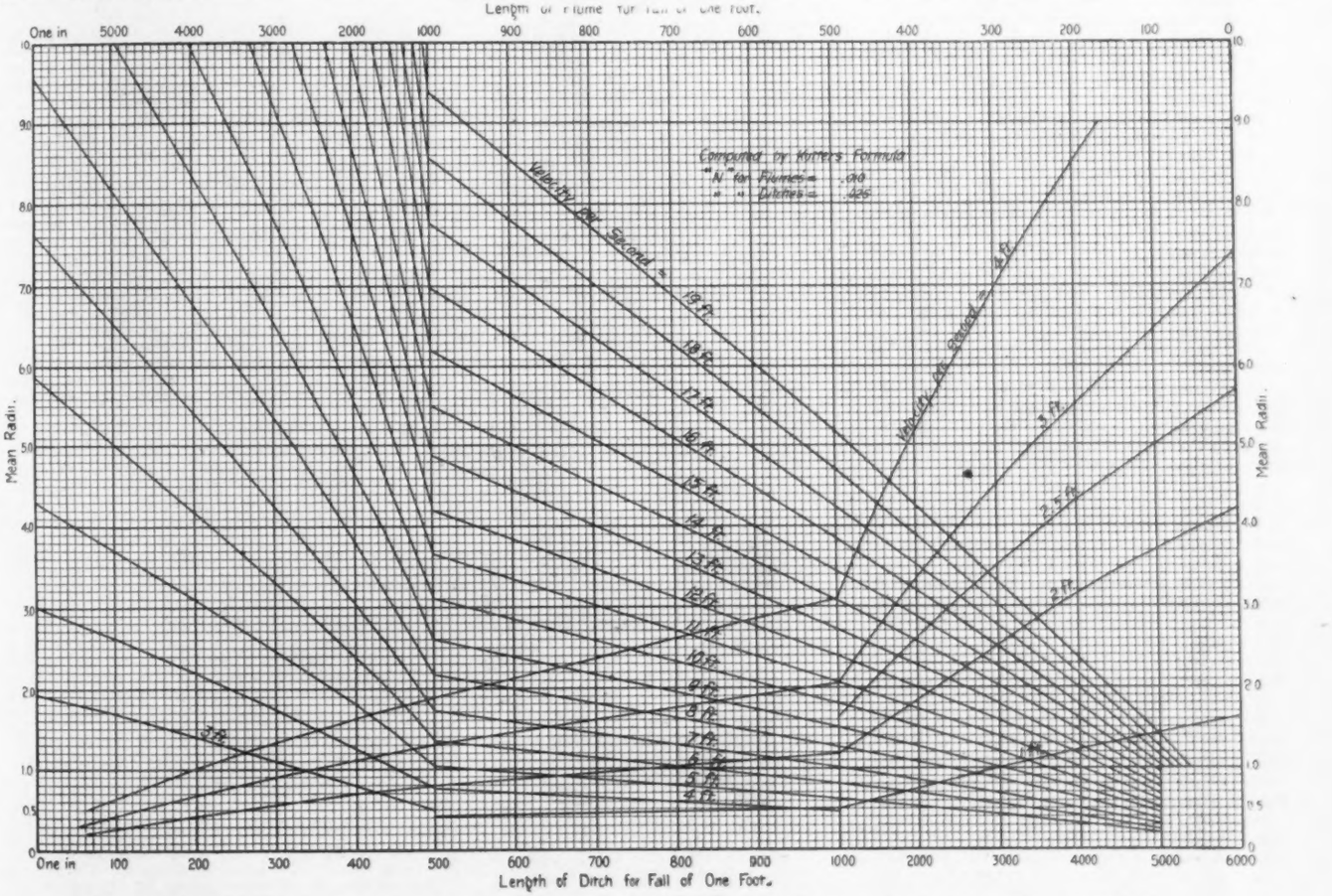

Length of Flume for Fall of One Foot.
One in 5000 4000 3000 2000 1000 900 800 700 600 500 400 300 200 100 0
Computed by Kutter's Formula
"N" for Flumes = .010
" " Ditches = .025
Velocity per Second = 15 Ft.
10 Ft.
8 Ft.
6 Ft.
5 Ft.
4 Ft.
3 Ft.
2.5 Ft.
2 Ft.
1.5 Ft.
1 Ft.
.5 Ft.
Mean Radii.
One in 100 200 300 400 500 600 700 800 900 1000 2000 3000 4000 5000 6000
Length of Ditch for Fall of One Foot.

DIAGRAM FOR CALCULATING VELOCITIES, GRADES AND MEAN RADII FOR FLUMES AND DITCHES; A. L. ADAMS, ENGINEER.

ACCIDENTS IN THE RAILWAY MAIL SERVICE.

In our issue of Sept. 12, 1891, we discussed the question whether railway accidents in the United States are increasing or decreasing, and attempted to find an answer by analyzing the official record of accidents in the railway mail service during the past 14 years. About 229,000,000 miles (about 75% of the whole passenger train mileage of the country) is made by trains carrying mail, so that the accident record is fairly representative of the average for passenger train service. The short period over which the statistics extend, however, and the fact that they seem to have imperfectly collected during the earlier years of the service, prevent any very certain conclusions being drawn as to the increase or decrease in frequency of the accidents. The most that can be said is that they are not decreasing in any marked degree, taking the country as a whole. The report for the year ending June 30, 1891, shows totals which compare as follows with preceding years:

Year ending June 30.	Total No. of clerks.	No. of casualties.	Clerks killed.	Clerks seriously injured.	Clerks slightly injured.
1887	4,851	344	5	45	72
1888	5,004	248	4	62	48
1889	5,448	193	10	26	40
1890	5,836	261	4	41	53
1891	6,032	319	13	68	84

It is seen that the number of clerks killed and injured during the fiscal year was much greater than in any year since the organization of the service. The large number killed is chiefly due to the Kipton, O., collision on the Lake Shore & Michigan Southern R. R., April 18, in which six clerks were killed. (Eng. News April 25, 1891.)

The last pages of the report contain a brief statement of each accident which occurred, outlining its cause, the total of resulting injury, and the injuries received by mail matter, postal car or clerks. Of

the 319 accidents, 122 (38%) were derailments and 112 (35%) were collisions. The remaining 85 (27%), were due to the following causes:

Misplaced or defective switches	26
Washouts and landslides	14
Obstructions on the track	14
Accidents on b idges or trestles	8
Defects of rolling stock	10
Miscellaneous	6
Casualties other than train accidents	7

Of the cases of obstruction on the track, 8 were animals and 4 were obstructions placed by train wreckers. It is of interest to note that 17 of the derailments, or about 14% of the total, are ascribed to broken rails. One derailment, which occurred Dec. 21, on the Union Pacific near Holmesville, Neb., was due to the engine striking a track jack, a cause of accident which was hardly realized as existing until the Old Colony disaster of August, 1890. That fearful accident does not appear in this record, as there was no postal car on the wrecked train.

Of the accidents caused by defects in rolling stock, 4 are ascribed to axle failures and 4 to wheel defects. Near Lowville, N. Y., Feb. 10, a loose wheel on the postal car broke that car from the forward portion of the train at a switch and it plunged into a box car on the siding.

There were 12 wrecks in which fire followed. The cause of the fire is given in only a few cases; but one, in which the car was destroyed, is ascribed to the stove, and 2 in which portions of the mail were burned are stated to have been set by the lamps. Besides these, there were 5 cases in which the car took fire when no train accident occurred. In 2 of these an overheated stove is given as the cause and in 1, which occurred on March 8 near Amsterdam, N. Y., the report states that "the origin of the fire is supposed to have been from the steam pipes." It is notable and somewhat suspicious that no fire is said to have started from matches or cigars or other carelessness.

In each accident the damage sustained by the mail matter is briefly stated and in 45 cases it is reported to have been more or less wet with oil from the lamps. On the previous year there were 35 accidents in which mail matter was reported as damaged by oil. Whether these figures include all the cases in which spilled oil came in contact with letters and papers, is not certain, as the mail matter in many serious wrecks is reported damaged when no description of the damage is given.

It is evident that the danger from oil lighting is much diminished when cars are not heated by stoves. What happens sometimes when they are is briefly stated for an accident which occurred at Taylorsville, Ill., Oct. 6, 1890, as follows: "Mail car was overturned and the mails slightly damaged by oil from lamps and hot coals from stove."

It will be observed that no single fire is said to have been started in the first instance by lamps. On the other hand, 1.97% of the total stock of postal cars in use had injuries to mail resulting from the spilling of oil, as an effect of some train accident, there being 45 such cases, in addition to 2 cases where the lamps started a fire after the wreck, out of a total of 12 such fires following wreck. The large number of 319 cars out of 2,281 in use, or 14%, suffered accident of some kind or other. In 45 + 2 = 47, of these cases, as above stated, oil was spilled from the lamps in quantities sufficient to injure the mails enough to demand report, while in the remaining 272 cases the oil lamps had no recorded effect upon the accident or its consequences.

In how many cases oil was spilled from the lamps and injury done to the car or mail without train accident, does not appear from the record, which covers only accidents to the cars or train.

THE NEW TRIPLE VALVE OF THE NEW YORK AIR BRAKE CO.

As stated in our last issue, the New York Air Brake Co. has recently perfected a new quick-action triple valve, and it is with this that the tests were made last week at Burlington, Ia., which are described elsewhere in this issue. We illustrate herewith both the old and the new triple-valves of the New York Air Brake Co., and also the standard quick-action freight triple-valve of the Westinghouse Air Brake Co.

It must be confessed that at first sight a triple-valve drawing appears so hopelessly complex that it discourages one from attempting to study it out. A little careful examination, however, with a knowledge of its method of working, shows the complexity to be more apparent than real.

All the triple-valves shown are designed to effect the same ends, although the mechanism employed varies considerably. When the brake is not in use, a passage is open through the triple-valve between the auxiliary reservoir and the train pipe. A passage is also open between the brake cylinder and the outer air. When an ordinary service stop is to be made, the engineer lets some of the air from the train pipe escape into the outer air and thus reduces the pressure in the train pipe 5 to 10 lbs. This causes the triple valve to close the connection between the train pipe and the auxiliary reservoir, and also that between the brake cylinder and the outer air. Air is then admitted from the reservoir to the brake cylinder in amount proportional to the reduction of pressure in the train pipe. To release the brake, the engineer restores the train pipe pressure to the original amount by letting air into it from the main reservoir. This moves the triple valve to its first position and opens again the communication between the reservoir and train pipe and that between the brake cylinder and the outer air, thus emptying the brake cylinder and releasing the brake.

In making an emergency stop the quick-action feature of the triple-valve comes into play. The engineer reduces the train pipe pressure suddenly 15 to 20 lbs., and this not only opens wide the passage from the reservoir to the brake cylinder by the mechanism above described, but also opens a passage directly from the train pipe to the brake cylinder. Thus the brake cylinder is filled very rapidly, and at the same time the reduction of train pipe pressure at each car quickly starts the triple-valves on the cars following.

Each of the triple-valves which we illustrate is designed to accomplish the ends described above, but there is considerable difference in the mechanism employed. The principal feature of interest in each valve is the mechanism employed for obtaining the emergency application. In the Westinghouse valve, Fig. 3, dependence is placed on the graduating spring (22). In service stops this is not compressed enough to permit air to be admitted from reservoir to cylinder except through the graduating valve (7). In emergency stops this spring is closed. The slide valve (3) makes its full travel and air is admitted from the reservoir to the brake cylinder through a larger passage and is also admitted on top of the piston (8) controlling the emergency valve (10). Thus the emergency valve is opened and the brake cylinder is quickly filled from both the train pipe and the reservoir.

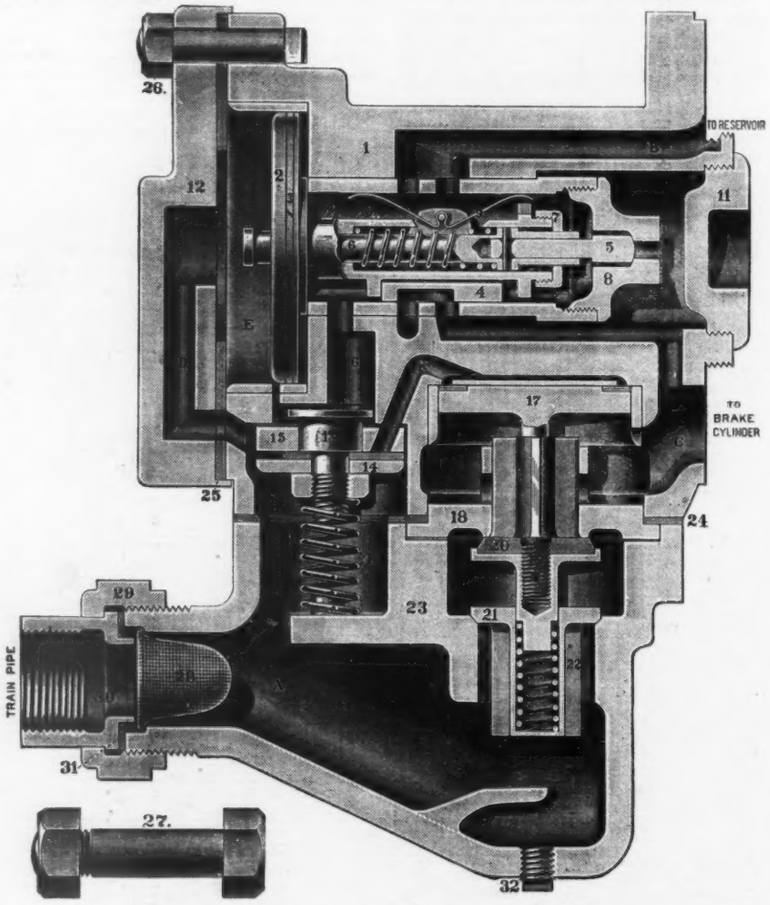


FIG. 1. OLD STYLE TRIPLE VALVE OF THE NEW YORK AIR BRAKE CO.

1. Triple valve body. 2. Main piston. 3. Main piston packing ring. 4. Slide valve. 5. Graduating valve. 6. Graduating valve guide. 7. Graduating valve guide nut. 8. Graduating valve seat. 9. Slide valve spring. 10. Graduating valve spring. 11. Plug. 12. Cap. 13. Differential piston. 14. Valve controlling emergency piston. 15. Valve seat. 16. Valve spring. 17. Emergency valve piston. 18. Emergency valve seat. 19. Emergency valve. 20. Emergency valve gasket. 21. Check valve. 22. Check valve spring. 23. Check valve case. 24. Check valve case gasket. 25. Cap gasket. 26. Cap bolts. 27. Check valve case bolts. 28. Strainer. 29. Union nut. 30. Union swivel. 31. Union gasket. 32. Drip plug.

The old style of New York valve, Fig. 1, depends for its quick action on a special valve (14), which is ordinarily held to its seat by a spring (16). The reduction of train pipe pressure in an emergency application causes motion of a piston (13), which is subjected to train pipe pressure on one side and reservoir pressure on the other, and this opens the valve (14) and admits air from the train pipe on top of the emergency valve piston (17), which acts the same as the similar part in the Westinghouse valve.

This valve worked satisfactorily in the testing rack at the company's shops and is reported to be giving satisfaction in ordinary freight service on over seventy railways. Recently, however, a private test was made with the brake on the Chicago, Burlington & Quincy R. R. on a 50-car train, and it was

found that the quick action could not be secured farther back than the 17th or 18th car. The cars with which this test was made were all new and the brake gear was so adjusted that the maximum travel of the piston was but 4 ins. This did not empty the train pipe sufficiently to carry the quick action through the train. It seems also probable that the difficulty with this valve is due in part to the small area of the differential valve, which gives it a small driving force to overcome any slight sticking.

To overcome this difficulty Mr. Albert P. Massey, Mechanical Engineer of the New York Air Brake Company, designed the valve illustrated in Fig. 2. The portion of the valve used in service stops differs but little from the same parts in the first style of valve. A "leakage groove" is used to afford communication between the train pipe and the reservoir in place of the small port which was formerly used, and there is some slight change in the mechanism controlling the graduating valve. The quick action part of the valve, however, is wholly new and is of very ingenious construction. As in the old style valve, a differential piston is used to control the quick action valve, having the train pipe pressure on one side and the reservoir pressure on the other. Referring to Fig. 2, (13) is the differential piston having train pipe pressure on its under side, and reservoir pressure on the upper; any reduction in the train-pipe pressure causes the piston (13) to move down until the end of its rod strikes the end of the rod connected with the emergency valve (14). The emergency valve is held to its seat by the train pipe pressure on its back. The port which the emergency valve covers is the end of a passage leading to the brake cylinder, so that the under side of the emergency valve is practically open to the atmosphere. It will now be seen that piston (13) and valve (14)

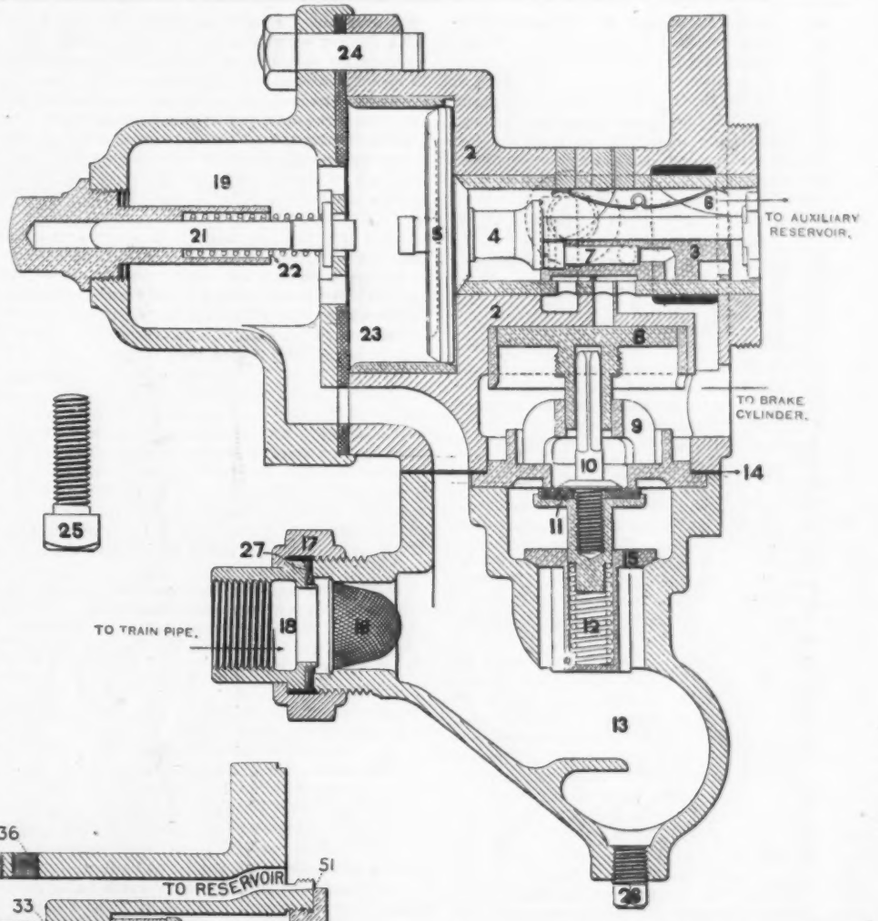


FIG. 2. NEW STYLE TRIPLE VALVE OF THE NEW YORK AIR BRAKE CO.

(Detailed parts are numbered the same as in the old style valve Fig. 1.)

constitute together a differential piston, and not until the difference of pressure on the sides of (13) is sufficient to overbalance the combined air pressure and spring pressure holding (14) to its seat will the emergency valve be opened.

In case an emergency stop is desired, however, the sudden and considerable fall of pressure in the train pipe starts piston (13) down very quickly, and the slight separation of the "buffers" between (13) and (14) permits the upper valve to attain a little momentum and forces open the emergency valve very rapidly.

FIG. 3. STANDARD QUICK-ACTION TRIPLE VALVE OF THE WESTINGHOUSE AIR BRAKE CO.

2. Triple valve body. 3. Slide valve. 4. Piston. 5. Piston packing ring. 6. Slide valve spring. 7. Graduating valve. 8. Emergency valve piston. 9. Emergency valve seat. 10. Emergency valve. 11. Rubber seat. 12. Check valve spring. 13. Check valve case. 14. Check valve case gasket. 15. Check valve. 16. Strainer. 17. Union nut. 18. Union swivel. 19. Drain cup. 20. Graduating stem nut. 21. Graduating stem. 22. Graduating spring. 23. Leather gasket. 24. Bolt and nut. 25. Half-inch cap screw. 26. One-half inch plug. 27. Union gasket.

It will be seen by the records elsewhere given that the valve worked admirably in every respect save in an especial test for quickness of release, made under conditions which are not reproduced in service. We have elsewhere described those conditions, but it may be explained here that apparently the only possible reason why the brake did not release was that the train pipe pressure did not rise above the pressure in the reservoir and the brake cylinder. Several causes were suggested for this. It is possible, though hardly probable, that the emergency valve (14) was not returned to its seat by the spring. This would of course permit any increase of pressure in the train pipe to pass directly to the reservoir and prevent the piston (2) from moving. Should this b the cause, it can be easily remedied by using heavier springs behind the emergency valve, or better yet for the check valve. The present check valve spring is only intended to keep the valve on its seat, but by increasing its strength, a slight excess of pressure would be secured in the train pipe, sufficient to start the differential piston (13) back and seat the emergency valve.

The more probable cause of the difficulty in releasing is leakage past pistons (2) and (13). Under the peculiar conditions of the test the pressure in the train pipe was increased very slowly, and a very little leakage past these pistons would prevent any excess pressure accumulating in the train pipe sufficient to move the pistons. The New York Air Brake

Co. state that in order to send off the valves in time for the test they were sent out without being tested for tightness, and they believe that under ordinary conditions of service no trouble will be found in releasing the brake. It is of course true that the New York valve has two pistons past which leakage may occur, while the Westinghouse valve has but one. Whether this would cause any practical difference in releasing in actual service remains to be seen.

We should state in this connection that patents are pending on the triple-valve illustrated in Fig. 2.

SOME RECENT BRAKE TESTS AT BURLINGTON.

On Feb. 3, 4 and 5 of last week a series of brake trials was made at Burlington, Ia., under the supervision of Mr. Godfrey W. Rhodes, Supt. Motive Power, Chicago, Burlington & Quincy R. R., to test the new triple valve of the New York Air Brake Co. and also compare the effect of different springs in the Westinghouse triple valve.

The Burlington road, as most of our readers will remember, recently ordered brake fittings for 2,000 cars from the New York Air Brake Co. which gave very unfavorable results when tested. In graduated or service stops the brake did well enough, but in emergency applications the action was very sluggish, so that it took some 20 seconds for the brake to apply on the 50th car, the triples, in fact, having no emergency action whatever beyond the 15th car, nd the brake cylinder pressure in the last car being only 50 lbs.

On Dec. 24, 1891, shop tests which were made of the same triple valve in the testing rack of the Westinghouse Air Brake Co., showed the same general defects in somewhat less degree. In the meantime the company was at work on a new triple valve (No. 2) which has now been tested. The difference between these two valves and between each and the Westinghouse, is explained in a separate article in this issue, and need not be here discussed. In general, the tests appear to indicate that the original difficulty with the No. 1 triple has been very successfully overcome with the No. 2, but that a new difficulty of much less importance has developed, namely, that the brakes do not release quite as readily as they should after an emergency stop.

Four successive trips were made with a 50-car trains as follows:

Feb. 3, a. m. New York new style triple valves on Westinghouse cylinders and reservoirs. It is noted that "the driver brakes and tender brakes did not bear well. They were new brakes and had not become fitted to the wheel," which would work somewhat against the first day's stops. The car brake shoes, we infer, were worn to fit to the wheel.

Feb. 4, a. m.: Westinghouse triple valves, new, with light graduation springs, No. 13 Brown & Sharpe w. g. (= No. 15, Birmingham w. g.).

Feb. 4, p. m.: Westinghouse triples, new, with heavy (No. 19 B. & S. w. g. = No. 13 B. w. g.) brass graduation springs, taken from valves that had been in use on palace stock cars for over two years.

Feb. 5, p. m.: Westinghouse triples, old, with heavy graduation springs as above, which had been in use for two years. The triples were tested just as taken from service, without cleaning or repairs.

The cars used were 34-ft. palace stock cars, which were overhauled about two years ago, and fitted with Janney couplings, metal brake beams, and quick-acting Westinghouse brakes. There was about 10 ins. of combined spring and loose slack between each car. The brake pressure was set at about 70 per cent. of the light weight of the cars.

The following is a reclassified record of the stops, which were made on the now well known Burlington test track, where the modern freight train brake may be said to have been born. We omit from the record only the time of the stop in seconds, which is of no special interest or importance, and the time in seconds between the movement of the engineer's valve and the occurrence of the shock, which was quite uniformly 6 seconds with all the brakes, ranging between 5 and 7 seconds as extremes. It will be observed that the severest shocks were in the front car, but none of the shocks were severe.

The conditions of the stops made were so different in respect to weather and state of rail that the percentage of efficiency is of com paratively little interest, and liable to be deceptive. Still we have computed it as a matter of general interest, and give it above in the right hand column, which shows the percentage of retarding force to the total weight of the train. Both the New York and the Westinghouse brakes showed very well in this respect, the New York the best, if it is fair to judge by the face of the returns.

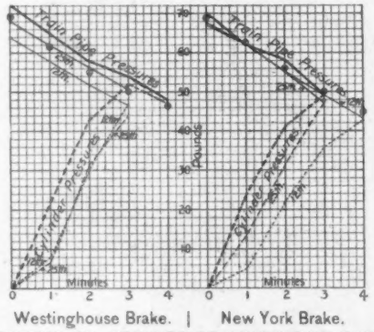
The following standing test was made to determine comparative quickness of application:

	Train-pipe pressure.	Applied in		Pressure obtained.
N. Y. triple valve. ...	70.72 lbs.	3 sec.	50lbs. in	4.2 sec.
W'st'gh'se. new lt. spr.	70.72 "	3 "	58 " "	4 "
" " hvy. spr.	68.72 "	3.2 "	59 " "	4 "
" old " "	66 "	3.2 "	55 " "	4 "

In the last test the train pipe pressure was only 66 lbs.; in the others, about 70 lbs.

No. 2 Tests: For Graduation.

To determine the graduation efficiency of the brakes, 26 cars were used standing still. Gages were attached to the train pipe and auxiliary reservoir of the dynamometer car, middle or 12th car, and rear or 25th car. A reduction of train-pipe pressure was made on the engine at 1 minute intervals, the handle of the engineer's valve being returned to lap after each application. The results obtained are shown graphically in the accompanying diagrams, the first of which shows the workings of Westinghouse new triples with heavy springs; and the second, results with the New York triples. The points in circles show the pressure at the engine gage just after each reduction. The heavy solid line shows the train-pipe pressure at the dynamometer car, and the heavy dotted line, the brake cylinder pressure. The other lines are for the 12th and 25th cars, as marked. In the 25th car the brake cylinder gage rose steadily from first application to equalization, and on the 12th car this was nearly so, but there was a pause at 35 lbs. The dynamometer car gage raised after first application continuously and slowly. There will be seen to be no considerable difference between the two brakes in respect to this test. No tests for graduation were made with the Westinghouse valve with a light graduating spring, and this seems rather unfortunate as it is a question whether the light spring could be used without giving an emergency application in ordinary service stops.



Westinghouse Brake. | New York Brake.

DIAGRAMS OF RESULTS OF GRADUATION TESTS.

No. 3 Tests: For Quickness of Release.

Twenty-five of the cars mentioned in the foregoing were used in these tests, standing still; 70-lb. train pipe pressure was first obtained. The engineer's valve was then placed at lap and 100 lbs. allowed to accumulate in the main air reservoir. Full emergency application was then made without letting all the air out of the train pipe. The handle was next placed at lap. After an intermission of 15 to 30 seconds, to insure an equalization of pressure between auxiliary reservoirs and cylinders, a signal was given from the engine whistle, and at the same moment the handle of the engineer's brake-valve was placed in running position. Observers were placed at intervals throughout the length of the train who kept record of the time it took to release the brakes from the signal. The are following the data obtained:

Westinghouse, New Valves and Heavy Springs.—All 22 cars off in 65 sec. (3 cars cut out or did not apply). The three rear cars released in 23 sec., and the four front cars in 50 secs. The summary of time is as follows:

Seconds....	65	61	50	46	37	30	23	22	13
Cars.....	4	1	4	1	1	6	3	1	1

Westinghouse Old Triple Valves.—All 26 cars off in 82 sec., the head and rear cars releasing in 20 sec. The summary of time is as follows:

Seconds..	10-20	21-30	31-40	41-50	51-60	70	82
Cars.....	5	7	5	3	3	1	1

New York Air Brake.—Of the 25 cars 1 released in 25 sec.; 2 released in 30 sec.; 1 released in 34 sec.; 1 released in 57 sec.; 1 released in 60 sec.; 1 released in 85 sec.; 1 released in 90 sec.; 1 was cut out, and 16 stuck, and did not release.

Of course, the conditions of this test were by no means favorable to quick release, since the train pipe pressure was admitted very slowly and not at all in the manner usual in service. We have commented on this in our description of the New York valve in another column.

No. 4. Single Car Tests.

This test was to determine if the emergency brake would go on in service application with one car. It was carried out in the same manner as test No. 2, and the result was substantially the same as shown in the diagrams above. After successive reductions of 10, 5, and 4 lbs., the result was, with both brakes, 50 lbs., in both train pipe and brake cylinders.

No. 5. Single Car Tests.

This was to determine if the emergency application would occur on one car with the engineer's valve placed in the service application position, releasing all the air from the train pipe.

With the Westinghouse brake, new triple, heavy spring, after letting all air out through the full service port, there was no emergency application.

With the New York brake, after letting all air out through full service port, the dynamometer-car cylinder gage moved up rapidly, and then the emergency went on. In a subsequent test, with six cars attached, the cylinder gage moved up rapidly, but there was no emergency application.

No. 1 Stops.—Level Grade.

Kind of triple valve.	Speed, m. p. h.	Slidometer. Rear car.	Slidometer. Front car.	Length stop, ft.	State of rail.	Pressure. Train pipe.	Pressure. Rear cyl. at shock.	Breakage. (Cars numbered from head.)	P. c. Efficiency of brake.
New York.....	15	+ 7.9	Not	93	Good.	70	60	None.	8.60
New York.....	26	+ 5.1	used.	267	"	72	55	Draft spring, 22d car.	8.08
W., new, lt. spr.	23	+ 0.0	+ 2.3	239.3	Bad.*	70	58	None.	7.86
W. " h'vy spr	23	+ 0.5	+ 1.3	232.5	Snowy	72	60	None.	8.07
W. old " " "	24.5	+ 0.3	+ 1.3	283.5		68	55	Knuckle, 20th car.	7.53

No. 2 Stops.—Level Grade.

New York.....	31	+ 3.4	(?)	360	Good.	70	58	Knuckle, 18th car.	9.47
W. new, lt. spr.	30	+ 0.2	+ 7.6	384.5	Bad.*	70	57	Tail stops, 42d car.	8.31
W. " h'vy spr	32	+ 0.8 / − 10.5	+ 2.5	388.5	Snowy.	71	60	None.	9.41
W. old " "	31	+ 0.3	+ 1.6	417.	Good.	67	55	Drawbar, 14th car.	8.18

No. 3 Stops.—53 ft. per Mile, Down Grade.

New York.....	18	+ 7.6	(?)	156	Good.	70	55	None.	8.36
W. new, lt. spr.	19	+ 0.1	+ 0.8	102	Bad.*	72	58	None.	8.91
W. " h'vy spr	22.5	+ 0.2	+ 2.2	238.5	Snowy.	68	57	Knuckle, 15th car.	8.54
W. old " "	21	+ 0.4	+ 4.5	190	Good.	69	55	None.	9.23

No. 4 Stops.—53 ft. per Mile, Down Grade.

New York.....	36	+ 0.0	(?)	574	Good.	70	58	Link at tender.	9.01
W. new, lt. spr.	36	+ 0.1	+ 1.3	646	Bad.*	70	58	None.	8.13
W. " h'vy spr	33.5	− 0.2	+ 0.3	561	Snowy.	68	55	None.	8.10
W. old " "	Track obstructed by freight train.			No stops made.					

"The " bad" rail here referred to is apparently due to the cloudy weather and light rain. The temperature is not stated.

A meteoric stone partly covered with a solid film of gold is reported as found near Cave City, Calaveras Co., Cal., by Mr. H. W. Turner, a geologist of Washington, D. C. The stone is about as large as a man's fist and is remarkable as being the first case noted where gold has been found in connection with meteoric iron. The specimen has been sent to the Smithsonian Institution.

CONSTRUCTION AND REPAIR OF COUNTRY ROADS.

At the Road Convention held recently in Trenton, N.J., a paper with the above title was read by Mr. James Owen, of Montclair, an engineer of wide experience in the construction and maintenance of highways. This paper is valuable from the many practical hints contained in it:

Mr. Owen commenced by saying that the three primary questions to be answered were — How to get the money to build roads; how best to lay out the road, and finally the proper way to build it. The question of finances was beyond the speaker's province, and the second point was hardly before a convention which had for its object the improvement of existing roads, and so to this latter point he directed his remarks, as follows:

Before going into the question of material for construction, it would be well properly to consider two or three points inherent to good work and applicable to all road construction. These are: The determination of grade, drainage and the finished shape of the road; and it may be safely said that no good and successful road work can be accomplished without a proper consideration of these three important items.

As to grade, it may be asserted that no road should ever be built on a level grade; and in my experience no grade should ever be less than 6 ins. in 100 ft., as much more as you can possibly get, up to 12 ins. in 100 ft., which is probably the most suitable grade for highways and gives a free and proper flow of the surface water from and off the road itself. Wherever water stands in a roadway of any kind (except of course city pavement), it has a tendency to disintegrate the material of which it is made, making it soft and easily influenced by the travel upon it. By a proper grade to your road you eliminate one source of trouble, namely, standing water. The extreme steepness of roads is of course dependent upon its location. A grade of 4 ft. in 100 ft. is the limit of good easy traveling, and anything steeper than 10 ft. in 100 ft. should not be allowed, and that grade should only be permitted in exceptional circumstances. The custom of having grades of 13 to 15 ft. in 100 ft. in mountain roads is a bad one, and is due to the haste the originators had to get there. But in all establishment of grade make the standard limits between 1 and 4 ft. in 100 ft. and you will always have satisfactory results.

Incident to the grade of the road is the shape of its finished surface, known generally under the name of its crowning or rounding. Good judgment and experience are more required on this one point than in any other question of road building. If the road is too flat the water will not run off properly and ruts are formed. If there is too much crowning the travel all concentrates in the center and ruts are occasioned in that way. If these ruts are on a steep grade the water follows them instead of running to the sides of the road, and tears out the material. Another point should be remembered, that a road should be constructed with an inch to a half inch more crown than is permanently designed for it, as the bulk of all travel is in the centre, and this would settle the centre more quickly than the sides. The writer's experience is that a crown of 12 ins. in a 30-ft. road, settling to 10 ins. soon after completion, is about the desideratum. An extra allowance of 2 in. should, however, be given to grades steeper than 5 ft. in 100 to shed water more quickly, and on all steep grades breaks or thank-you-marms should be put in about 400 ft. apart to make the shed doubly sure.

On the matter of proper drainage I would lay especial stress. Of course I do not suggest in the construction of these proposed state roads that an elaborate system of underdrainage should be undertaken, but I do insist that under certain circumstances and certain conditions money spent in properly removing accumulating waters is money saved.

In ninety-nine cases out of a hundred it is cheaper to dig or ditch, to drain a hole or pocket or swamp, than it is to fill the place up, yet to my knowledge money, time and energy have been wasted in filling with stones and boulders wet and low places in roads, with still unsatisfactory results, when, if one-tenth of the time and energy had been consumed in draining these same places, permanent success might have been insured. In one particular case I remember, on a road that had been traveled for over 100 years, and during that period stones and boulders had been dumped to keep teams and loads from getting mired, on my proposition of lowering the grade of the road and removing these stones I was solemnly assured of the folly of such a proceeding and undoing a century's work. The result, however, proved the contrary, as a good road has existed ever since the new grade was made.

What I would suggest, however, in the general drainage is, that with proper grades care should be taken to shed the water thoroughly at the low points, and if the grades are long also at proper intermediate points. Where quicksand is struck, or soft, boggy ground, special provision must be made to avoid permanent and unceasing repairs. Quicksand can always be permanently treated by proper drainage, but bogs and swamps of large area cannot usually be so handled. The use of brush and similar material is usually best to make a permanent road under the latter conditions.

Incidental to the crowning and grade, is the proper surfacing of earth for the reception of the road material. Under all circumstances and at all times should the surface of the ground be similar to the finished surface of the roadway, with proper shoulders to hold the material in shape. No dumping the broken stone haphazardly on the existing uneven surface and then spreading it to make the top uniform. This never will, never has made a good roadway, and it is an essential element for successful results in roadmaking to dig out to the depth necessary, to trim off with a proper crown, and then put on your stone.

The next problem for consideration is the material to be used for the finished surface, and without taking into consideration the various materials used and suggested for roads, there is only one fit to be used for good permanent results, and that is trap rock. There is plenty of it in New Jersey, and the only problem is to get it to the place where it is wanted.

This summary conclusion only applies to the finished surface. My own practice is almost uniformly to use a foundation for the support of the broken stones. Occasionally under pressure of circumstances I have built thin roads, but not of my own free will except on steep grades. In fact, of later years I have been varying the thickness of roads according to the grades, making them 10 ins. thick for grades flatter than 1 ft. in 100; 8 ins. for grades between 1 and 4 in 100, and 6 ins. for grades steeper than 4 ft. in 100. This practice I have found gives uniform good results. I am satisfied, however, that it is feasible in a country with gravelly soil to lay thin pavements and have them last well, but in no other localities except on steep grades do I think it wise to have no foundation.

The material for foundations may be of any durable stone; even water-worn sandstone is not objectionable; but if round they should be broken into parts, as such round stone are apt to work to the surface. In my early construction of roads I was very strenuous about having trap rock foundations, and even now mostly use that material for that purpose, as it is as handy as any other in the region in which I am constructing roads, but in sections of the State remote from trap rock quarries I do not think it economy to haul the foundation stone so far.

Under all circumstances the foundation stone should be laid by hand, close together, firmly wedged with smaller stone on top, and this whole mass thoroughly sledged to a uniform surface.

And just at this point I want to lay special stress on the importance of sledging, and wedging any foundation that is put in, for in my observation in the ordinary practice of repairing country roads it has been customary to use a great deal of field stone to help out these soft places, and with proper handling of the material used in such places, a fairly successful road might have been made. The result, however, after the layer of earth that had been put on had been washed or worn off, the road was very uneven and very much rutted, and somewhat of a torture to travel on. The cause of this was due to the fact that whereas in wedging and sledging the foundation you are enabled to distribute the load of a heavy wagon traveling over it, under the old way the concentrated weight came on individual stones, which sink and yield an insecure or yielding bottom.

The thickness of foundation should not be less than 5 ins. and as thick as the run of the material will permit. I built a mile of road with the foundation stone taken out of an old stone fence. It was found cheaper to put them on the road as they were than to break them, and the result was the foundation averaged about 10 ins. thick. I must strongly allude, however, to the danger of using perishable stone in the foundation. Better have none at all than material liable to decay.

Having laid and constructed a good foundation for the road, it is then ready for the top course, which should be, except in very special occasions, of trap rock. Before putting in the broken stone, it is better to spread a thin layer of loam or clay, just sufficient to fill the spaces of the stone and make an even surface. Care should be taken not to have too much, as it does no good and harms the road. This packing, as it is called, is put there to prevent the bottom stones from coming up and mixing with the top course, which they are almost sure to do without its interposition. The usual size for the broken stone is from 1½ to 2 ins. in diameter, for on this part of the work depends the future smoothness of the road, and only men specially adapted to this kind of work should be allowed to do it. In my experience, few men have or get the proper knack of spreading.

After the stone has been put on to the proper thickness and evenly spread, it should then be rolled, and here comes in again another point of discussion. Years ago it was considered imperative in the construction of a good road to have a steam roller. Experience, however, showed that a road could be constructed as well without it, and the trouble caused by the breaking in of culverts, scaring horses and deterring travel generally, within a mile of a steam roller led first to its condemnation by the community, and finally to its abandonment. No steam roller is used to my knowledge on any of the roads in Essex county, and I am glad of it.

A roller weighing about 2 tons, easily moved by 2 horses is all that is necessary, costing say $150 to $175, which should be purchased and owned by any community which is building roads.

The rolling of the top stone should be sufficient to bring the stones down to a fairly uniform surface; another thin coating of loam is put on, and this is then repeatedly rolled, and the usual practice is on to put top of this a coat of broken stone screenings, which is then rolled, and then travel is allowed to come on.

I wish to say at this point, that while the top coating of screenings is very desirable, where great economy is desirable I think it can be dispensed with, for if it is possible to repair roads by covering them with a coating of 3 ins., and then rolling it properly and covering it with loam, I see no reason why new roads cannot be finished off in the same way. It requires a little more care, and you have to have a certain amount of travel to make it a success. I repaired the main avenues of Essex County in that way for years, and their condition was an endorsement of the method.

To do it properly, however, after the top stone is rolled and the coating of loam is also rolled, let the travel come right on. This makes ruts and furrows which a repeated rolling will remove, and let this be kept up till the surface is consolidated. The roller need not be kept in one spot all the time; let it go ahead and roll a new piece; come and smooth off an old piece, and so backwards and forwards, still, however, progressing regularly forward.

When you have arrived at this period of your road's construction the general idea is that that is all, but I wish to say here very emphatically, not yet. A new road, like a new watch, wants watching and adjusting to get it into a new, permanent shape, and for the first year it wants to be looked after with some care.

After the settling and adjusting have taken place and everything is satisfactory, a road built as here outlined will last from 3 to 5 years for ordinary country travel. I have known a pavement always in good condition to run 10 years without repairs, and in my own case parts of the old Pompton turnpike, with fairly heavy country travel, had no repairs on them for 5 years, and were good at all times.

Now I come to another feature of the road question, which to my mind is more important than all others, and that is their repair.

While the road taxes in this State show that the repair of ordinary earth roads is an accepted fact and money is voted therefor all over the State, when a pavement is laid down there seems to be a sort of recognized feeling that when it is built that is the end of it. Far from it.

In repairing roads, I want to depart from the usual accepted doctrine and say do not patch. The old practice and theory of keeping men on the roads perpetually tinkering and mending is wrong in principle and expensive in practice. If a road is built properly it should wear uniformly, and when its thickness is so reduced that it is necessary to re-cover it with broken stone, let it be done in sections as large as you please, from a mile to one-half a mile, and it should be laid, spread and rolled in the same manner as described for the building. Of course, it may and undoubtedly will be, necessary to touch up stray places that under peculiar conditions are defective. These should be attended to, but as a general practice I say again, do not patch.

The remarks I made about screenings in construction are still more applicable to repairs. If you can afford it, put them on; they make a nice road, but are expensive, as a coating of loam costs $30 to $50 a mile and a coating of screenings $300 to $400.

We now come to the important question of cost. Roads built in the manner I have described cost in Essex Co. 60 to 80 cts. per lin. ft. 16 ft. wide, according to their thickness and the distance the material has to be hauled, including foundations of quarry stones. This would be $3,000 to $4,000 per mile. By using local stone for foundation and local help in hauling and as much as possible local labor, and also reducing width on many of the local roads to 14 ft. and even 12 ft., I think the cost throughout the State might be placed at $2,500 per mile, provided due economy and wise administration is secured.

In the cost of repairs a proper recoating of the surface in the same locality will cost from 20 to 25 cts. per lin. ft. for a 16 ft. road. This, by reducing the width and supposing a renewal every five years, would amount to about $150 per mile on the average. On the basis of $2,500 per mile for construction and $150 per mile per annum for repairs, let us see where the problem would land us.

By the report of the different municipalities and townships submitted to the Governor for the year 1888 we find 169 townships reporting an expenditure of $537,000 for the construction and repair of public roads. There are about 247 townships in the State and basing the calculation on the same rates would give an expenditure of $785,000. As, however, these returns include the counties of Hudson, Essex, Bergen, Passaic and Union, which have and are now completing a system of roads of their own at a large expense, it would be proper to deduct these counties from the above statement. Deducting therefrom the reported expenditure of 35 townships in those counties amounting to $238,368, we have the reported expenditures of 134 townships amounting to $299,000 for

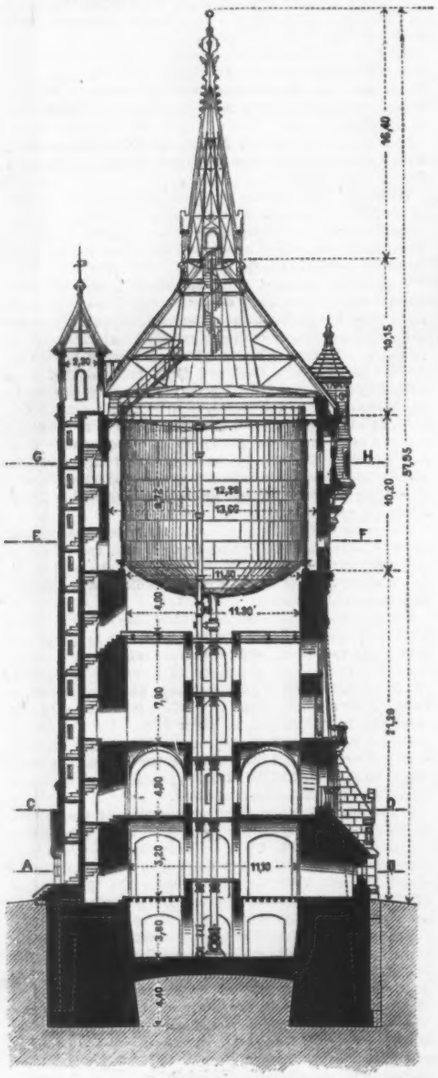
the rest of the State. As there are about 202 townships outside the five counties mentioned, this would give us an expenditure of $150,000 in one year for the repair and maintenance of their roads, which in ten years would amount to the sum of $4,510,000, enough to pave and macadamize, on the basis of $2,500 per mile, 1,800 miles of roads—and repair 3,000 miles of pavement for ten years. In making a superficial estimate of the miles of roads in the State, I find they run about 50 miles to a township, so with 202 townships there will be about 10,000 miles of road to improve outside the five counties.

The most astonishing part of the matter, to my mind, is that this vast sum of $451,000 per annum is practically thrown away. Roads that have been in existence 50 or even 100 years have had enough money spent on them to make them and keep them as first class macadamized roads, yet practically they are in the same condition now as years ago, always bad.

WATER TOWER AT WORMS, GERMANY.

In a late issue of the "Centralblatt der Bauverwaltung," the water tower erected at Worms is illustrated. It is really an elevated tank, 40 ft. in diameter and carrying 29 ft. of water, resting upon circular walls of masonry, somewhat similar to the Norton water tower of the Vyrnwy water supply, in England, but much smaller in its lateral dimensions.

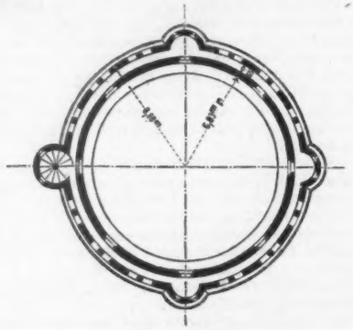
The exterior of the tower is Romanesque in style, with a circular cross section, on a base diameter of 67 ft. The tower is 69½ ft. high from the ground level to the ring supporting the tank, 103 ft. to the base of the roof, and 190 ft. to the top of the spire.



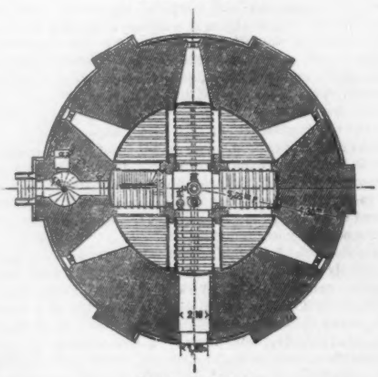
Vertical Section.

The foundation is carried down 33 ft. to a gravel stratum, and is entirely of concrete. The main tower is built of coursed stone lined with brick above the base of the tank. The lower story, but-

VIEW OF WATER TOWER AT WORMS, GERMANY.



Section A B.



Section G H.

tresses and decorative features are red sandstone, and the upper part a yellow-gray sandstone.

The roof has an iron frame covered with plank and glazed tiles, paper being placed between the wood and the tiles. The small dormer windows and the cornices are made of sheet copper.

The water reservoir is 40 ft. 4 ins. in diameter, and measured from the lowest point of the curved bottom, is 36 ft. 9½ ins. high. The inlet and outlet pipes are 15½ ins. in diameter, and pass through stuffing-boxes in the bottom of the tank. The tower was put into service in September, 1890, and cost about $53,000, including land purchased.

The American Bridge Manufacturers' Association recently had its private affairs made public through a suit at law brought by the Phœnix Bridge Co. against the other members of the association. The organization was formed in 1887. A "guarantee fund" was raised amounting to $52,000, the percentage contributed by each member being as follows:

	Per cent.		Per cent.
Keystone Bridge Co.	10.00	Detroit Bridge & Iron Works	6.54
Phœnix Bridge Co.	16.30	Cofrode & Saylor	7.00
Union Bridge Co.	16.00	C. J. Schultz	4 00
Edge Moor Iron Co.	9.75	D. H. Andrews	2.76
New Jersey Steel & Iron Co.	7.75	John F. Alden	5.35
Passaic Rolling Mill Co.	7.00	M. Lassig	2.10
Morse Bridge Co.	5.75		

This guarantee fund was increased by an assessment of 0.4 ct. per lb. on all work done by each company until it amounted to $260,000. When the Kings County Elevated Ry. in Brooklyn was built, the Phœnix Bridge Co., which received the contract, was exempted by vote of the association from paying the assessment on not more than 40,000,000 lbs. of material. The Phœnix Co. claimed the right to construct also the Fulton Elevated Ry. under the same conditions, holding that it was practically an extension of the Kings County road. The association, however, levied an assessment of about $33,000 on the Phœnix Co. on account of its Fulton Elevated contract. The Phœnix Co. at that time had an interest in the general guarantee fund of the association amounting to $40,000, and it brought suit to prevent the other members of the association from depriving it of its rightful share in the funds and benefits of the association. This suit has been pending for about two years, and a decision was recently announced by Judge Beach, of the New York Supreme Court. He held that the original contract was void, being of a monopolistic nature and against public policy. This was not, indeed, denied by the counsel for the plaintiffs, but it was contended by them that notwithstanding this, a court of equity might grant relief to a party to such a contract who had suffered injury. The court refused to entertain this view, and declared the contract void and non-enforceable.

The Schenectady shops of the Edison Electric Co. present one of the best examples in the country of the electric distribution of power. The total floor space in the works at present is 11.84 acres, nearly all of which is in one-story buildings. The central power station contains Edison and Armington & Sims engines aggregating 1,075 HP., driving various sizes and types of Edison dynamos. When complete the station will have a boiler plant aggregating 3,000 HP. The largest output of current at one time thus far made is 950 HP. The total number of motors receiving current in and about the works is 43, aggregating 1,324 K.-W. (1,775 HP.) While this is largely in excess of the central station's present capacity, it is of course true that the motors could not possibly all be in service to their full capacity at one time. A large proportion of these motors drive lengths of shafting in the different shops, a point worthy of note, for it is often stated that the best way to distribute power electrically is to attach a proper-size motor directly to each machine. The example set by the electrical companies certainly shows it to be preferable to use one motor for a group of several machines, driving them from a line shaft. The total length of shafting driven by electric motors is 5,260 ft. The total length of wire circuit supplying current to the motors and the electric lamps is 20,000 ft., not including the wiring inside the shops. The motor circuit has an E. M. F. of 250 volts, and half this tension is used on the lighting circuit. Practically all the outdoor conductors are put underground.

Besides the motors driving line shafting, there are electric hoists, an electric elevator, electric overhead cranes and an electric derrick in the yard for unloading freight cars—four applications of electricity for lifting purposes. Other motors drive a Baker ventilating blower with a capacity of 3,300 cu. ft. of air per minute, a locomotive which can haul a train of 120 tons at 7 to 12 miles per hour and a pump for running a hydraulic elevator. The central station also furnishes current for the Schenectady electric railway.

The largest output of iron from a blast furnace in a single month ever recorded was made by Furnace I of the Edgar Thomson works at Braddock, Pa., during the month of January. The total product for the month was 12,706 gross tons, or an average of nearly 410 tons per day. The highest week's record was 3,005 gross tons, and

the greatest output in 24 hours was 511 tons. The average fuel consumption was 1,760 lbs. per gross ton. The best previous record was made by furnace F, of the same plant, which has produced 11,000 tons in a month, 2,850 tons in a week, and 566 tons in 24 hours. Mr. Jas. Gayley, General Manager of the furnace department of the Edgar Thomson works, may well feel proud of the new record.

House building in Philadelphia for the past year did not reach former records, as is shown by the following tabulation of new buildings erected: In 1891, 6,738 houses were built, as compared with 10,136 in 1890, and 10,250 in 1889. Out of the number given for 1891, 4,632 buildings were only two stories high, and the estimated cost was $2,000 each. The total amount invested in new buildings, alterations and additions for 1891 was nearly $28,000,000. Tenement buildings, of many stories and many families under one roof, are evidently and fortunately for the poorer class not popular in Philadelphia. We believe, too, that there are but three or four modern apartment houses of the better class in that city.

The Baltimore Belt Railroad has decided to build a large passenger station at the corner of Liberty and Lombard Sts., close to the business center of the city.

The drawbridge over the Harlem River, at Seventh Ave., New York, is advertised to-day by the Department of Public Works for proposals. The work consists of a draw 412 ft. long with a 40-ft. roadway and two 12-ft sidewalks; also 16 spans of lattice girder, each 83 ft. long, resting on stone piers, and 480 ft. of embankment between retainining walls. The principal estimated quantities are as follows: Drawspan, 2,444,000 lbs.; turntable, 750,000; approaches, 5,417,000 lbs.; dredging, 7,400 cu. yds.; pneumatic caisson work, 3,870 cu. yds.; excavation, 7,500 cu. yds.; masonry, 13,360 cu. yds.; retaining walls, 2 675 cu. yds; filling, 8,500 cu. yds. The plans and specifications can be seen at the Department of Public Works and at the office of the Consulting Engineer, Mr. A. P. Boller, 71 Broadway, New York.

California bids fair to become a prominent source of supply for asphaltum. Besides the deposits in Santa Barbara and Ventura counties, which have been worked for several years, extensive deposits are now being worked in Kern County, 45 miles southwest of Bakersfield, by the Sunset Oil Co. Five wells, from 90 to 300 ft. deep, yield a heavy oil termed Maltha, at the rate of 50 to 60 bbls. per day. The asphaltum occurs in pools which are sometimes acres in extent, and it is mined and mixed with the heavy oil at the rate of a ton to two barrels, then heated and purified for shipment. Including the cost of hauling to the railroad, about 45 miles, the refined asphaltum can be delivered on board the cars, at a cost of about $20 per ton. The capacity of the plant at present in operation is about 12 tons per day. High freight rates ($40 per ton to Chicago) prevent the company from marketing its product in the East.

Very recently a deposit of bituminous rock has been discovered within the city limits of Los Angeles, and it is stated that several fine veins of asphaltum have been uncovered and a small stream of oil has been flowing from the excavation. The bituminous rock is to be utilized for fuel. It is of interest in this connection to note that California is second only to Pennsylvania and Ohio in petroleum production, her product having increased from 15,227 bbls. in 1878 to about 350,000 bbls. in 1889.

The electric lighting plant for the grounds and main buildings of the World's Columbian Exposition is now being advertised for. Proposals for leasing electrical machinery and apparatus for the general illumination of the grounds by arc lights will be received until March 15 by Mr. D. H. Burnham, Chief of Construction.

The New York & Long Island R. R. Co., which proposes to build a tunnel under the East River from near 42d St., New York City, to Long Island City, has accepted the conditions of the franchises which have been voted upon by the Aldermen of the two cities.

A bill appointing a commission of three members to have general supervision over all the railways in the State is before the New Jersey Legislature. The cost of the commission is not to exceed $25,000 per annum, to be paid by the railway companies in proportion to their wealth. According to the provisions of this bill the commission would be empowered to examine into all details of operation, may call for books and papers and have the same power as the courts regarding witnesses. All causes of accidents are to be thoroughly investigated and unjust discrimination as to fares, etc., prevented, necessary repairs enforced, new stations built when ordered, etc. The bill is so sweeping that it will never pass, say those who know of what they speak.

The Pennsylvania Railroad station at Broad St., Philadelphia, is being extended. The new addition will take in the block of stores facing Market St. between Broad and 15th Sts., and enable the company to put down 15 or 16 tracks instead of the present 12 tracks. More than 450 trains in 24 hours pass in and out of this station, and the vastly increased traffic of the past few years makes the extension absolutely necessary to avoid aggravating delays in handling trains.

The Memphis Bridge, across the Mississippi River, it is said, will be finished in about 30 days. About 500 ft. on the Memphis side yet remain to be finished, says the "Appeal Avalanche" of that city.

Chile wants to build a strategic railway along the coast from Valparaiso to Iquique, a distance of 1,000 miles, and is now said to be attempting to float a $25,000,000 loan in London, Paris and Amsterdam for this purpose. Iquique is now separated by a wide, arid desert from the rest of the country.

The new Burlington bridge across the Mississippi River at that city, is about completed. It is a double track railway bridge costing $400,000, and replaces the first iron bridge to span the Mississippi, built in 1865-66 at a cost of $1,200,000. The old bridge could not stand the heavier equipment of the present day and the enormously increased traffic.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

WILLIAMSPORT & NORTH BRANCH.—This company has been reorganized with the following officers: Pres., Henry C. McCormick, V.-P., John Satterfield, Treas. J. H. Cochrane, and Sec. S. T. McCormick. According to reports it is the intention of the new company to take steps toward completing the line to Williamsport, Pa., at once.

CONCORD & MONTREAL.—Tracklaying will be resumed on the line from Jefferson to Berlin, N. H., 17 miles, about April 1. Caldwell & Varnum, of St. Johnsbury, Vt., are the contractors.

BEAVER & ELLWOOD.—A 3¼ mile extension is being built to coal lands south of Ellwood Junc., Pa.

LANCASTER, CECIL & SOUTHERN.—This company has been chartered in Maryland to build the Maryland division of the proposed Lancaster, Oxford & Southern R. R. The route will be from Elkton, Md., north to the Pennsylvania line. It is stated that grading will begin soon.

PENNSYLVANIA.—Surveys are in progress for an extension of the Turtle Creek Valley R. R. from Murraysville to Belmont, Pa. Construction will be begun soon.

LEHIGH VALLEY.—Surveys are in progress for a branch from Tremont to Lebanon, Pa.

WABASH.—Pres. Jas. F. Joy is reported as saying that the $3,500,000 of bonds of this company have been sold, and that arrangements have been all completed for building the proposed line from Montpelier, O., to Hammond, Ind.

CLEVELAND BELT & TERMINAL.—The right of way difficulties, which have delayed work on this belt railway at Cleveland, O., have been largely overcome, and it is stated that construction will now be rapidly pushed. The work is about 10 miles long.

NEW YORK CENTRAL & HUDSON RIVER.—This company has purchased the Carthage & Adirondack R. R., running from Carthage to Benson Mines, N. Y., 43 miles.—It is stated that work is now in progress on the plans for the proposed locomotive repair and construction shops at Buffalo, N. Y.

LONG ISLAND.—The New York Bay Extension R. R. Co., has been chartered in New York to build a railway from Garden City, on Long Island, to Brooklyn, at or near the intersection of the New Lots road and the tracks of the New York, Brooklyn & Manhattan Beach R. R.

PITTSBURG, AKRON & WESTERN.—It is rumored that this company will build an extension east from Akron, O., to connect with the Cleveland & Canton R. R., during the coming season.

NEW YORK, SUSQUEHANNA & WESTERN.—It is reported that this company is negotiating for terminal facilities of its own in Jersey City, N. J. Its trains now run into the Pennsylvania station at Jersey City over the Pennsylvania's tracks from West End. The Susquehanna people are talking of building a double track to the river and constructing large piers of their own.

Projects and Surveys.

YORK & SCHUYLKILL.—Incorporated in Pennsylvania to build a railway from Red Lion, York Co., Pa., to Lorberry Junc., Schulykill Co., Pa., 65 miles. Pres., Chas. R. McConkey, Peach Bottom, Pa.

MIDDLETOWN & HUMMELSTOWN.—It is proposed to build a line of railway from Middletown to the Hummelstown brownstone quarries. Allen Walton and others of Philadelphia, Pa., are interested.

WESTERN INDIANA.—A press dispatch from Laporte, Ind., says: "A company with a capital stock of $200,000 has been organized and incorporated to build a railroad from Hammond, Lake Co., to this city. The road will connect with the great Eastern trunk lines, and at this point will merge with the Chicago and West Michigan, opening direct communication with the lumber regions of Michigan and the coal fields of Indiana. Chicago capitalists are interested in the success of the project."

MANISTIQUE & NORTHERN.—This proposed railway from Manistique to Negaunee, Mich., surveys for which have just been completed, will be about 90 miles long. The route is through a good timber and mineral country affording fairly good work. It is stated that arrangements are now being made for beginning work.

BROWNSTONE & MIDDLETOWN.—This company has been chartered in Pennsylvania to build a railway from Brownstone to Waltonville, Pa. The line will be 2½ miles long and a portion of it has been in operation as a quarry road for some time. The object of the new company is to improve and equip the road to do a general business. Pres., Albert Walton, Hummelstown, Pa.

CHICAGO, INDIANAPOLIS & CHATTANOOGA SOUTHERN.—F. L. Patrick, of Columbus, O., writes us that this line has been located from Rockport to Mitchell, Ind., 70 miles, and that the contracts for construction will be let about March 15. The grades and curves are easy and the work quite light. There will be one bridge of three spans and a 1,500-ft. tunnel. D. P. Irwin, of Indianapolis, Ind., Pres.; J. H. McCormick, Columbus, O., Ch. Engr.

BOSTON, SCRANTON & CHICAGO.—It is rumored that a charter will be procured for a company by this name to build a railway from Milford, Pa., to Hoadley's, Pa. The line will connect at Milford with the proposed line from that place to Deckertown, N. J., which is to be built under the name of the New York, Scranton & Chicago R. R. The length of both lines will be about 45 miles.

Southern.—Existing Roads.

BIRMINGHAM, SHEFFIELD & TENNESSEE RIVER.—Surveys have just been finished for an extension of this road to Birmingham, Ala., about 40 miles.

RICHMOND & DANVILLE.—The Elberton Air Line R. R., running from Elberton to Toccoa, Ga., 51 miles, will probably be changed to standard gage this season.

MORRISTOWN & CUMBERLAND GAP.—It is rumored that this road will be extended from Corryton to Nashville, Tenn.

ALABAMA GRAND TRUNK.—T. J. Adams, the contractor, has sublet the contract for building 5 miles of this road to H. McCall, who will begin work about March 1.

OHIO VALLEY.—Work has been begun on the 5-mile branch to Hopkinsville, Ky., with a force of several hundred men. The line is to be completed by July 1.

ATLANTIC COAST LINE.—The grading has been completed on the extension from Greenville to Washington, N. C., 20 miles, and tracklaying will begin at once. About 150 men are now at work.

WILMINGTON & WELDON.—Tracklaying is rapidly progressing on the line from Latta, S. C., to Clio, S. C., 18 miles, 6 miles being already finished. It is expected to have the line open for traffic early in the spring.

ROANOKE, FINCASTLE & CLIFTON FORGE.—Work on this line between Fincastle and Troutville, Va., 12 miles, has been resumed. The line is to be completed by May 1.

CHESAPEAKE & OHIO.—The contract has been let for a new pier to cost $300,000 at Newport News. Work will soon be begun upon a depot to cost $100,000 at the same place.

NORFOLK & WESTERN.—Press dispatches state that work is making very good progress upon the Ohio extension.—Construction will probably soon begin upon the proposed branches up Russel and Big Toms creeks.—Surveys have been completed for several short branches to coal lands near Abingdon, Va.

MACON & ATLANTIC.—An application has been made for the sale of this partly graded railway from Macon, Ga., to the Atlantic coast, at auction. This is stated to be the first step of a reorganization plan, by which both this line and the Macon & Birmingham R. R. will be sold to their bondholders and consolidated with the Macon, Dublin & Savannah R. R.

BIRMINGHAM & JONES VALLEY.—This company has filed a mortgage for $1,000,000 with the Knickerbocker Trust Co., of New York City, the proceeds to be used in building its proposed line from Birmingham to Gadsden, Ala.

Projects and Surveys.

MISSOURI, EAST TENNESSEE & VIRGINIA.—Ch. Eng. L. C. Wolkins, 258 Washington St., Boston Mass., writes us that this road is projected to run from Memphis, Tenn., east via Nashville and Knoxville, to Bristol, Tenn., 685 miles. The surveys will be completed by Feb. 15, and the right of way is about two-thirds secured. The route is very favorable, affording easy work and light grades and curves. There will be two large bridges at Perryville and Knoxville, Tenn. One division of 110 miles has been put under contract, and it is expected to have 55 miles of track laid by June 1. The line from Bristol to Perryville is expected to be completed by Jan. 1, 1894. Geo. M. Buttrick, of Everett Mass., is President, and John F. Wolkin's Sons & Co. are the engineers. E. L. Suffron, 50 Broadway, New York City, is the New York representative of the company.

BAYARD, PETERSBURG & MOOREFIELD.—At the recent meeting of the directors of this company J. C. Hoffman, Jr., Wheeling, W. Va., was elected President and J. S. Jameson, of Piedmont, Va., was elected Vice-President. The proposed road is to run from Bayard to Moorefield, W. Va., 40 miles.

VIRGINIA.—A bill has been introduced in the legislature incorporating the Southampton, Greensville & Brunswick R. R. Co., with E. C. Gates, Bradley L. Eaton, R. H. Sizer, J. P. Thomas and others as corporators. The company proposes to build a narrow gage road from some point in Southampton Co., on the Nottoway River, through that county and Greensville and Brunswick counties to some place on the Atlantic & Danville R. R. The capital stock is to be not more than $500,000.—A bill to incorporate the Wytheville Belt, Atlantic & Western R. R. Co., is before the legislature. The line is to begin in Wythe or Smythe counties and extend through Rich Valley, Poor Valley or Walker's Creek Valley through Bland, Smythe, Tazewell, Buchanan or other western counties, and through Wythe, Grayson, Carroll, Floyd and Patrick counties.—The Rappahannock R. R. Co. has applied to the legislature for a charter to build a railway, commencing at Richmond or within 7 miles of that city, to deep water on the Rappahannock River or Chesapeake Bay. The capital stock is to be not less than $100,000 nor more than $3,000,000.—A bill has been introduced in the legislature to incorporate the Roanoke Valley R. R. Co., to build a railway from the city of Roanoke through the counties of Roanoke and Botetourt to a point in Rockbridge Co., Va. The incorporators are W. P. Huff, M. C. Thomas, C. A. Moomaw, R. H. Woodrum and others.—The bills incorporating the Norfolk & Camden R. R. Co., and the Chesapeake, Shendun & Western R. R. Co., have passed the Virginia State Legislature.

EAST GEORGIA & FLORIDA.—It is stated that a syndicate of Northern capitalists will purchase the property of this company and build the proposed road. Surveys have been completed from Jesup to St. Mary's, Ga.

Northwest.—Existing Roads.

KEARNEY & BLACK HILLS.—This company which built 66 miles of railway from Kearney to Calloway, Neb., in 1890, proposes, it is stated, to build an extension from Calloway northwest to Gandy, Neb., this season.

JACKSONVILLE & SOUTHEASTERN.—The citizens of Greenville, Ill., have raised the money necessary to secure the construction of a branch to that place. It will be about five miles long.

DULUTH, PIERRE & BLACK HILLS.—The money necessary to complete this railway from Pierre to Aberdeen, S. Dak., 75 miles, has been secured, and it is stated that work will be resumed at an early date. The larger part of the grading is completed.

CHICAGO & EASTERN ILLINOIS.—This company is making surveys for an extension from Shelbyville to Herrick, Ill.

DULUTH, MISSABE & NORTHERN.—C. H. Martz, of Duluth, Minn., Ch. Engr., writes us that the location has been made for this line from Duluth to Section 3, township 58, range 18 west, a distance of 100 miles, and that the contract for construction has been let to Donald Grant and Foley Bros. The route is very favorable for this section of the country; maximum grade 26.4 ft. per mile and maximum curve 5°. It is expected to begin tracklaying by June 1, and to have the road completed by Sept. 1, 1892. Prest., K. D. Chase, of Duluth.

PAWNEE.—Chartered in Illinois to build a railway from Sullivan to Roodhouse, Ill. The incorporators are the officers of the Pawnee R. R., running from Auburn to Pawnee, Ill., 9 miles, 5 miles of which were built in 1891.

BALTIMORE & OHIO.—Press dispatches state that surveyors are now locating a line in the interest of this company from Havana, Ill., to Keokuk, Ia., and thence southwest to Edina, Mo., in the interest of this company. The route is practically the same as that of the Chicago, Keokuk & Southwestern R. R., previously noted.

GREAT NORTHERN.—Press dispatches state that steps are being taken which indicate the commencement of work on the proposed extension north from Park Rapids, Minn.

Projects and Surveys.

CLOQUET LUMBER CO.—This company proposes to build a railway from a point on the Duluth & Winnipeg R. R. in township 52, range 23, north to timber lands in township 60.

WINNIPEG & SOUTHEASTERN.—According to the Manitoba papers there is some prospect of a portion of this proposed railway from Winnipeg, Man., to the International being built this season.

OTTAWA, STARVED ROCK & WESTERN.—Chartered in Illinois to build a railroad from Ottawa to Starved Rock, La Salle Co., Ill. Among the incorporators are: Chas. F. Wilson, Chas. S. Cullen, John J. O'Brien, all of Ottawa.

MINNEAPOLIS & ST. PAUL.—A press dispatch says: "Minneapolis business men are raising a bonus for a second interurban line, which Mr. Lowry promises to build and have in operation by July 1, at the latest, if the bonus is raised by March 1. The bonus it is said, is so nearly raised that it is practically an assured fact that Mr. Lowry's terms will be complied with. The line will be less than half a mile longer than the existing line, and will bring a large part of St. Paul almost as near the Exposition Building, where the Republican National Convention is to be held, as is the residence portion of Minneapolis."

JOLIET, DEKALB & NORTHERN.—Chartered in Illinois to build a railway from Joliet to De Kalb, Ill., and ultimately to Beloit and Milwaukee, Wis. Among the incorporators are: W. L. Elwood, De Kalb, Ill., L. A. Mason, Joliet, Ill., W. W. McDonald, Chicago, Ill., and others.

TERRE HAUTE, SAILOR SPRINGS & CHESTER.—This company has completed its organization by electing the following officers: Pres., B. F. Scaiefe; V.-P., L. W. Barnes, Sec., A. E. Rhoades, and Treas., A. G. Allen. The incorporation of this company was noted in our issue of Jan. 23.

MANKATO & NORTHEASTERN.—Chartered in Minnesota to build a railway from Mankato, Minn., to Duluth, Minn.

MANITOBA & JAMES BAY.—This company will make application to the Canadian parliament for a charter to build a railway from Winnipeg, Man., east to a connection with the Canadian Pacific Ry., and thence north to the head of navigation on the Albany River.

RED RIVER VALLEY.—Chartered in Minnesota by T. A. Sullivan, of East Grand Rapids, Minn., C. W. Peterson, of Grand Forks, Minn., and others to build a line of railway.

OTTAWA, STARVED ROCK & WESTERN.—Chartered in Illinois to build a railway from Ottawa to Starved Rock, La Salle Co., Ill. The capital stock is $150,000.

Southwest.—Existing Roads.

MISSOURI, KANSAS & TEXAS.—A report is in circulation that this company proposes to extend its line from Boonville to St. Louis, Mo.

LOUISVILLE, NEW ORLEANS & TEXAS.—Surveys are in progress for a line from Jackson to Ethel, La., about 5 miles.

KANSAS CITY, FT. SMITH & SOUTHERN.—At a meeting of directors of the Kansas City, Fort Smith & Southern road, held Feb. 4, the following officers were elected: Pres., B. Stevens, Jr.; Supt., P. D. Peters; Aud., B. W. Requa; Gen. Atty., J. W. North. It was stated that the extension of the road to Fort Smith would be immediately begun.

Projects and Surveys.

BRIDGEPORT & DECATUR.—It is stated that work will be resumed on this 14-mile line from Bridgeport to Decatur Tex., by March 1. Ch. Eng., Chas. E. Moore, Decatur, Tex.

KANSAS, MIAMI & SOUTHERN.—Chartered in Kansas to build a railway from Columbus, Cherokee Co., Kan., into the Indian Territory. Principal office, Columbus, Kan.

Rocky Mt. and Pacific.—Existing Roads.

BURLINGTON & MISSOURI RIVER.—This company, it is stated, will build a branch from Barr Station, Colo., to the Carlsbad mineral springs, 4 miles.

NORTHERN PACIFIC.—The Chihalis-South bend branch will soon be opened for traffic from Chihalis, Wash., west to Pe Ell, 20 miles. Between Pe Ell and South Bend all but 16 miles of the grading has been completed and work is making good progress.—An official of this company is reported as saying that surveys would begin for a line from Centralia., Wash., to Cowlitz, Wash., in the early spring.

PUGET SOUND AND PACIFIC OCEAN.—Contracts will be let in a few weeks for the 12-mile line to connect this road with the Northern Pacific line in Mason Co., Wash.

DENVER, APEX & WESTERN.—It is stated that the necessary financial arrangements have been completed, and that work will soon begin building this proposed railway from Denver to Georgetown, Colo. H. A. W. Tabor, of Denver, is interested.

SANTA FE, PRESCOTT & PHŒNIX.—An official of this company states that grading from Ash Fork, Ariz., south toward Phœnix, is making good progress. According to press reports an additional force will soon be put at work and the line rapidly pushed to completion.

Projects and Surveys.

HELENA & CASTLE.—A committee has been appointed to consider the feasability of building a railway from Helena to Castle, Mont.

ELECTRIC RAILWAYS.

ROCKLAND, ME.—The franchise of the Rockland street railway has been acquired from the Knox & Lincoln R. R. Co. by the Thomaston and Rockport & Camden street railway companies. Permission has been granted by the Rockland authorities for the commencement of work on the electric road as soon as the frost permits, and 1½ miles are to be completed by July. Mr. Getchell is the engineer, and has been over the ground with Mr. Geo. E. Macomber, of Augusta, and Mr. W. B. Ferguson, street railway contractor, of Boston, Mass.

PROVIDENCE, R. I.—The Interstate Street Ry. Co. proposes to extend its electric road to Woonsocket and to purchase the plant of the Woonsocket Street Ry. Co.

HUNTINGTON, W. VA.—A company has been organized to build an electric railway 16 miles long to Central City, Ceredo, Kellogg, Kenova, Catlettsburg and Ashland. It is intended for passenger and light freight traffic. Mr. F. N. Fordyce, of Detroit, Mich., is at the head of the project.

WATERLOO, IA.—The Waterloo & Cedar Falls Construction Co. has been incorporated by D. B. Lyons, W. F. Stotts and G. S. Polk, of Des Moines, to build an electric railway between Waterloo and Cedar Falls Capital stock, $200,000.

KANSAS CITY, KAN.—It is proposed to adopt electric traction on the elevated railway.

NEW COMPANIES.—Montgomery & Cloverdale Electric Ry. Co., Montgomery, Ala.; A. W. Lebron, R. P. Dexter and P. Coleman. Lebanon & Meyerstown Electric Ry. Co., Lebanon, Pa.; $100,000; Pres., Jacob M. Shenk. Carbon County Electric Ry. Co.; $60,000; to build a line between Weisport and Mauch Chunk; Pres., Ambrose P. Clemmer, Philadelphia, Pa. Creede-Amethyst Electric Railway & Power Co., Denver, Colo.; $100,000; to build a line in Saguache County; David G. Peabody, R. T. Root and R. M. Kennedy, of Denver.

ELEVATED AND CABLE RAILWAYS.

BALTIMORE, MD.—The North Avenue Electric Ry. Co. has applied for permission to build an elevated road into the center of the city. The company will equip about 20 miles of its road with the cable system this year. The City Passenger Ry. Co. will shortly begin work on the roadbed for the cable system on its lines.

SAN FRANCISCO, CAL.—Mr. J. W. Hartzell, Manager of the San Francisco & San Mateo Ry., which is to be in operation next month, has applied for a franchise for an elevated electric railway. The columns are to be 12¾ × 18 ins. section, 26 ft. long, with 6 ft. in the ground. They are to be on the curb line, connected by transverse plate girders 3 ft. deep, carrying longitudinal lattice girders 48 ins. deep. The road and equipment are to be on the Meiggs system.

NEW YORK, N. Y.—The Sixth Ave. street railway has been acquired by the Metropolitan Traction Co., which owns the Broadway cable road, and the company will probably eventually adopt the cable system for the Sixth Ave. line.

PHILADELPHIA, PA.—The Quaker City Elevated Ry. Co.'s ordinance has been passed by the council. Mr. Thomas Briggs, of Newtown, Bucks Co., Pa., is president of the company.

HORSE RAILWAYS.

NEW COMPANIES.—City Railway Co., Valparaiso, Ind.; $25,000; C. D. Haines, F. P. Collier and J. T. Gardiner. Punxsutawney Street Ry. Co., Punxsutawney, Pa.; $18,000; Pres., J. K. North.

HIGHWAYS.

NEW YORK.—The Board of Supervisors of Queens County, at Long Island City, has approved the specifications prepared by Mr. Roulfer, the engineer, for macadamizing 3.2 miles of highway between Jamaica and Flushing, and has directed the engineer to advertise for proposals. The estimated cost is $45,000. The town of Rye will issue $10,500 in bonds for road purposes.

PENNSYLVANIA.—A meeting to consider the macadamizing of roads in Abington township has been held at Abington, and J. A. Romig, H. B. Worrell and A. K. Williams have been appointed a committee to consider the matter.

OHIO.—George McCausland, Robert Thompson and Thomas Kane, Road Commissioners, Steubenville, have reported the location of 24 more miles of pike in Jefferson County. The County Commissioners adopted the routes as laid out, and about ten miles will be built the coming summer.

BRIDGES, TUNNELS AND CANALS.

NEW BRUNSWICK, N. J.—Bids will be received until Feb. 16 for building a stone arch bridge over the Raritan River. Hezekiah Warne, New Brunswick, N. J.

GREENVILLE, MISS.—Bids will be received until March 7 for building a bridge at Fish Lake.

MANITOWOC, WIS.—A bridge to cost $30,000 will be erected at this place.

WATER-WORKS.

New England.

BOOTH BAY HARBOR, ME.—Last fall several large property owners bought of the Potter Manufacturing Co. a stand-pipe located on Mt. Pisgah. Later some of the parties secured a transfer to themselves of a water-works franchise or charter granted by the last legislature. There is now talk of building works.

MANCHESTER, N. H.—The Council has accepted a report from a committee recommending that the building of a high service system be referred to the next Council, as the limit of the city's borrowing capacity has been reached.

CHICOPEE, MASS.—Alderman Mellen, J. A. Carter and others have been appointed by the Council to investigate municipal ownership of works. The committee has power to employ experts. The Chicopee Water Co. owns the present works, and, as previously noted, has applied for permission to increase its capital stock.

GREAT BARRINGTON, MASS.—The works of the Great Barrington Water Co. have been appraised at about $35,000 and of the Berkshire Heights Water Co. at about $23,000. If the fire district buys the works it is expected that about $14,000 will be expended for extensions.

HOLYOKE, MASS.—There is talk of turning one or more available brooks into the present water supply by building a dam or dams. The dam at Ashley Pond may be raised from 3 to 5 ft.

NORTH ATTLEBOROUGH, MASS.—The fire district has petitioned for authority to extend its supply to Falls Village and Robinsville. It is said that there is no opposition.

PROVINCETOWN, MASS.—At a town meeting Feb. 9 it was voted to build works.

SOUTH HADLEY, MASS.—Fire District No. 1 has applied for authority to issue bonds for establishing works. No objections were raised at the legislative hearing.

NEWPORT, R. I.—Steps are being taken to secure from the legislature authority for the purchase of the company's works.

PROVIDENCE, R. I.—It is reported that Comr. Smith will soon recommend the construction of a filtering basin near the Sockanosset reservoir and the purchase of a 15,000,000-gallon pumping engine.

MIDDLETOWN, CONN.—Bids are wanted by the Water Commissioners until Feb. 16 for 505 tons of 12 to 4-in. cast-iron pipe and ten tons of specials; also for 12 hydrants and 57 12 to 4-in. valves.

NEW HAVEN, CONN.—It is reported that the New Haven Water Co. expects to begin the construction of a 600,000,000-gallon reservoir on April 1. The dam will be 60 ft. high and over 1,000 ft. long.

Middle.

MEDINA, N. Y.—It is reported that the capital stock of the new company is $96,000 and that J. Nelson Tubbs is Engineer, and C. J. Bauer, both of Rochester, Superintendent of construction. The company has accepted the franchise. It is said that the supply will be from springs, and that construction will be started soon

PINE PLAINS, N. Y.—Works are still projected.

ASBURY PARK, N. J.—The Indian Spring Water Co. has been incorporated by A. Judson Clark, Newark; B. T. Demarest, Passaic; C. W. Stout, Asbury Park; and others, to supply West Asbury Park in Neptune Township; capital stock, $100,000.

OCEAN CITY, N. J.—It is reported that works are projected, the supply to be brought from Somers Point through a main laid beneath Great Egg Harbor Bay, the whole distance being three miles.

HANOVER, PA.—The Borough Council has voted to submit to the people at a special election the question of issuing 4% bonds to the amount of $50,000 for water-works, and to the amount of $25,000, for an electric lighting plant. The "Herald" advocates the purchase of the company's works and the enlargement of the Pigeon Hill reservoirs, and the replacing of some of the mains by larger ones.

MARCUS HOOK, PA.—The Marcus Hook Water Co. has been incorporated; Treas., Henry P. Walter. Capital stock $1,000, all paid in.

MONTOURSVILLE, PA.—Jas. P. Herdic, Williamsport, has appeared before the Borough Council in connection with the proposed works.

NICHOLSON, PA.—There is a "rumor" that works will be built.

PHILADELPHIA, PA.—Councils Water Committee has voted, 16 to 4, in favor of locating the proposed new subsiding reservoir to be located upon the Schuetzen Park site. Director of Pub. Wks. Windrim favors the site. The estimated cost of the reservoir is $900,000, and of a 48-in. force and two 48-in. supply mains from the reservoir, $583,000. The reservoir would cover 65 acres, and have a capacity of 325,000,000 gallons. The committee also voted in favor of a 36-in. main to connect the Morris City and Corinthian Ave. reservoirs. The above matters, as we understand it, now go to the full council for decision.

STEELTON, PA.—The Council is discussing the water supply question.

Southern.

GOLDSBOROUGH, N. C.—There is talk of extending the mains through the Fifth Ward. Mgr., H. P. Dortch.

NEW BERNE, N. C.—The Council has referred to the Committee on Water-Works the proposal of Wm. C. Clarke to build and operate works.

ALBANY, GA.—Engr. John C. Chase, Wilmington, N. C., has reported on the cost of works, which he estimates at $65,200. This includes 12 miles of 12 to 4-in. pipe, two 1,500,000-gallon pumps, two boilers, building 350,000-gallon reservoir, 150,000 tank, with 90-ft. tower. Three artesian wells with connections, and some pipe already laid have been offered the city for $16,919. An election to vote on the issuance of $100,000 of bonds for water-works and sewerage will be held March 8.

ATHENS, GA.—The Council has ordered an election to be held March 10 to vote on the issuance of $125,000 for the building of works or the purchase and improvement of the present plant.

ORANGE CITY, FLA.—It is reported that the Orange City Water-Works Co. has contracted with nearly all the grove and property owners for a supply of water for irrigation and domestic use, and that a $175,000 plant is proposed.

North Central.

AKRON, O.—It is reported that the Akron Cold Spring Co. will enlarge its reservoir. Secy., P. D. Hall, Jr.

GLENDALE, O.—At the April election the people will vote on the issuance of $35,000 of bonds for works.

NAPOLEON, O.—The granting of water and electric lighting franchises to Howe & Hoigt, Norwalk, is under consideration by the Council.

SALINEVILLE, O.—A bill has passed the State Senate authorizing the village to issue $40,000 of bonds for works.

WESTON, O.—Feb. 15 the people will vote on issuing $10,000 of bonds for works.

WILLOUGHBY, O.—Feb. 16 a special election will be held to decide whether the proposed works shall be built by the town or a company,

CHICAGO, ILL.—A 5,000-ft. extension of the Hyde Park tunnel is under consideration.

GENEVA, ILL.—It is reported that works are projected

and that the plan includes the use of a pump in a factory; estimated cost, $10,000.

Northwestern.

SHELDON, IA.—It is reported that the construction of works, for which bonds were voted last fall, will soon be started.

UDALL, KAN.—It is reported that in the stand-pipe burst recently, owing to the freezing of the water.

BUTTE, MONT.—The city wishes bids until March 16 from parties desiring to build and operate works with a daily capacity of not less than 2,500,000 gallons. The supply must be by gravity from a reservoir or reservoirs with a capacity of at least 10,000,000 gallons, so located as to give a continuous hydrostatic pressure of not less than 65 lbs. per sq. in. upon any hydrant in any part of the city. Water must be furnished free for flushing sewers in such quantities as the City Engineer may direct and water must also be furnished free to public buildings. There must be at least 80 fire hydrants and bids must state at what rates water will be furnished to these and other hydrants which the council may order. The bidders must also specify rates to be charged private consumers. The bids must be based on a five-year contract and also on a longer term to be named by the bidder. If a contract of more than five year is made the city reserves the right to reduce the rate to consumers after five years. The city also reserves the right to control by ordinance the company which may build works. Address J J. Harrington, Cy. Clk., F. W. Blackford, Cy. Engr.

Southwestern.

HANNIBAL, MO.—Bids will be received by E. Whittaker, Prest. Hannibal Water Co., until Feb. 29 for building a 16,000,000-gallon reservoir, and for supplying and laying pipe and specials to connect the reservoir with distributing system. Chas. H. Ledlie, Consult. Engr., St. Louis; Chas. J. Lewis, Supt.

BATESVILLE, ARK.—The council has awarded the franchise for water and electric lighting plants to J. E. Hart. Hot Springs.

DE LEON, TEX.—Efforts to secure works are being made.

DENTON, TEX.—A report states that the council has contracted with the Denton Water, Light & Power Co. for works with a daily capacity of 100,000 gallons; also for electric lights. Another report states that the pump for the works has been placed in position; capacity, 100,000 gallons.

FORT WORTH, TEX.—The Arlington Heights Water Co., has been incorporated by A. W. Chamberlain, A. W. Tallant and W. C. Winthrop; capital stock, $100,000.

QUANAH, TEX.—It is reported that the Council is willing to aid in the construction of works.

SULPHUR SPRINGS, TEX.—Works are said to be almost a certainty. W. C. Hargrove has taken charge of the matter.

Pacific.

SPOKANE FALLS, WASH.—The Water Commission, it is reported, has accepted the proposition for new works made by F. Lewis Clarke, the price being $770,475.

ETIWANDA, CAL.—Steps are being taken by the citizens to introduce water for domestic use.

LOS ANGELES, CAL.—The City Water Co. has offered to sell its property to the city for $2,500,000

POMONA, CAL.—The Citizens' Water Co. has been incorporated; directors, F. J. Smith, J. B. Camp and others; capital stock, $150,000. A company already supplies the town.

IRRIGATION.

DENVER, COLO.—The Fairmount Cemetery Association will, according to a report, build a 5,000,000-gall. reservoir for irrigation.

NAMPA, IDAHO.—The Palouse-Pasco Land and Irrigation Co. has been incorporated by C. H. Alexander, Benj. F. Walling, E. H. Hesse and others; capital stock, $750,000. The company proposes to construct a canal leading from the Palouse River; Chf. Eng., E. Hesse, Boise City, Ida.

NEW COMPANIES.—Buffalo Rapids Ditch Co., Miles City, Mont.; $7,500. Mendocino Land & Water Co., Mendocino (probably), Cal.; directors, G. G. Buckland, P. H. Johnstone and others. Paloma Mountain Water Co. (incorporated in West Virginia), New York City; F. D. Rounds, New York; T. E. Bond, Oceanside, Cal., and others; $5,000,000; storing and distributing water for the irrigation of land in the county of San Diego, Cal., also supplying cities and towns with water, constructing and operating electric railroads.

SEWERS.

BOSTON, MASS.—The contract for section 22, at Medford, has been awarded to Andrew W. Bryne, of Somerville The bids were published last week.

REVERE, MASS.—The sewerage committee report the total estimates for the new sewers at $81,400. The town has voted to borrow $75,000, and the committee is instructed to construct the system at once.

NEW HAVEN, CONN.—Sewer bonds for $100,000 have been voted.

GREENPORT, N. Y.—The citizens have voted in favor of a sewerage system and a franchise will be granted to a local company.

SOUTH ORANGE, N. J.—At a special meeting of the village trustees Feb. 4 the reports of the two engineers, C. P. Bassett and W. Howard White, were presented and also that of the expert engineer, John T. Bogert. Resolutions were passed adopting the system of downward filtration on the Woodruff farm; inviting representatives of Wyoming, Millburn, Springfield and Rahway to consider their plan; employing C. P. Bassett as engineer, and for issuing $25,000 of sewer bonds.

RENOVO, PA.—The council has divided the borough into districts and passed ordinances for the construction of sewers in the same.

SUNBURY, PA.—The Sunbury Sewer Co. has been granted a franchise for the construction of a system of sewers. Mr. Ira T. Clement is a member of the company.

WILKINSBURG, PA.—The engineers report the lowest estimate for a practicable system to be $127,000. without the right of way, which would cost nearly $20,000. By an additional outlay of $31,000 Brushton would be enabled to drain into the sewer, though the latter is negotiating with Pittsburg for connection with the city sewers. The council has called a public meeting to discuss the matter of sewers and the issuing of sewer bonds.

LYNCHBURG, VA.—The council has voted to issue $30,000 of sewer bonds.

ALBANY, GA.—Mr. J. C. Chase has completed his surveys for a sewerage system. He estimates 11 miles of 8 and 12-in. pipe sewer at $39,700. An election will be held March 8 to vote on the issuing of $100,000 of bonds for water-works and sewerage.

ATLANTA, GA.—Ordinances have been adopted for 11 sewers, the largest to cost $19,000 and the total $67,922.

AKRON, O.—Mr. Parshall, Cy. Engr., has prepared profiles for a new drain sewer to be 5 miles in length and cost $48,000.

INDIANAPOLIS, IND.—Engineer Mansfield has submitted an exhaustive report on the question of city sewerage, in which it is claimed that the city needs nearly 200 miles of new sewers, to cost $2,000,000. The Board of Public Works is negotiating with an expert to examine the report and designate the kind and location of sewers. The city bears none of the expense for sewers, and it is intended to begin soon the building of as many as is possible and not be burdensome on the property owners

AURORA, ILL.—The Mayor has been instructed to ask for bids for building of sewers in District No. 1.

ANN ARBOR, MICH.—A vote is to be taken on issuing $25,000 of bonds for sewerage.

SPRINGFIELD, MO.—Additional sewer bonds to the amount of $100,000 have been sold.

PORT TOWNSEND, WASH.—Plans for a sewerage system have been prepared by G. N. Miller, of St. Paul, and adopted by the City Council. The plans include about 77 miles of sewers and the estimated cost is $777,378. Mr. Miller has recently completed plans for a system of sewerage at Whatcom.

STREETS.

PLYMOUTH, PA.—A vote is to be taken on a proposed loan of $15,000 for street improvements.

WILMINGTON, DEL.—The Street and Sewer Department finds it will require $350,000 to pave the streets that need improving. About $200,000 will be spent this season.

WESTMINSTER, MD.—The city proposes to issue $15,000 of street improvement bonds.

RALEIGH, N. C.—The Street Committee is arranging for considerable paving. Belgian blocks will be used on the streets subject to heavy travel and others will be macadamized to the city limits, to connect with the township's macadamized roads.

BIRMINGHAM, ALA.—The Street Committee is authorized to ask bids for paving three alleys with 4-in. Belgian blocks, sheet asphalt or asphalt blocks, according to the specifications of the City Engineer.

CHATTANOOGA, TENN.—Bids are asked for about $100,000 of paving with brick granite, asphalt and macadam.

MEMPHIS, TENN.—The engineer is preparing specifications for paving Second St, with brick. Bids will soon be asked.

CINCINNATI, O.—The Board of Administration has awarded the following contracts to the lowest bidders: Kirchner & Scully, granite on Hunt St., $85,518; J. Birnbaum, macadamizing Riddle road, $24,634; Warren-Scharf Asphalt Co., asphalt paving on Grand St., $25,125; J. Dermott, granite on Colerain Ave., $106,647; Hayes & Quill, granite on 13th St., $21,855.

TOLEDO, O.—Additional street improvement bonds to the amount of $67,152 have been sold.

CHICAGO, ILL.—The Board of Public Works asks for $4,243,412 for the ensuing year, a good part of which is for the construction and maintenance of streets and sewers.

PEORIA, ILL.—Ordinances have been passed for paving 9 streets with brick and 2 with asphalt.

SPRINGFIELD, MO.—The contract for paving 12 blocks on West Walnut St with brick has been awarded to James Reilly, at about $20,000.

ELECTRICAL.

HICKSVILLE, N. Y.—Mr. Julius Augustine is interested in a company recently purchased to furnish electric light to the villages of Hicksville, Jericho, Central Park, Plain View and Farmingdale.

DOYLESTOWN, PA.—The Doylestown Electric Co. has contracted to light the city for three years at $80 per lamp, lights to burn all night.

ATHENS, GA.—The Committee on Lights has recommended that the city buy the plant of the Gas & Electric Light Co.

MOBILE, ALA.—The General Council has rejected all proposals and will readvertise for bids for city lighting.

CINCINNATI, O.—The Public Welfare Society urges the city "to take immediate steps to secure or construct and operate a municipal electric lighting plant." Many of the city officials are said to favor the plan.

INDIANAPOLIS, IND.—The Board of Public Works opened bids for electric street lighting Feb. 8. The Ft. Wayne Electric Co. offered to erect 85 towers, each 125 ft. high and hanging 5 lamps, at $140 per light, the total cost be $62,250 per year, and if these did not properly light the city, it would put in 50 or more lights without extra cost to the city; the contract to be be for 5 or 10 years. The Indianapolis Brush Co. offered to furnish 750 lights to burn all night at $95 per light per year, the contract to be for 10 years. It also agreed to put the wires under ground. Both bids will probably be rejected.

CHICAGO, ILL.—Bids are asked until March 15 for leasing electrical machinery and apparatus for the general illumination of the grounds of the World's Columbian Exposition by arc lights. Address D. H. Burnham, Chief of Construction, Rookery Building.

KALAMAZOO, MICH.—The City Council asks bids for the construction of a 200 lamp plant.

ELDORA, IA.—An electric light company has been incorporated with a capital of $15,000.

NEW COMPANIES.—Milton Electric Light & Power Co., Milton, Pa.; $40,000; Treasurer, H. T. Buddy, Lower Chichester Electric Light, Heat & Power Co., Lower Chichester, Pa.; $10,000; Treasurer, Henry P. Walter, Media, Pa.; Haverford Electric Light Co., Haverford, Pa.; $40,000; President, L. T. Paul; Secretary, E. A. Scott. Quinsigamond Electric Power & Light Co., Worcester, Mass.; $10,000; President, Horace H. Bigelow, Treasurer, Irving E. Bigelow, both of Worcester Universal Power Co., New York; $15,000; Wm. A. Nicholson, New York, John S. Bell and N. H. Tatlor, Brooklyn. Meyersdale Electric Light Co., Meyersdale, Pa; $18,000; President, S. D. Livingood, Secretary and Manager, W. W. Staub. Arlington Heights Electric Co., Fort Worth, Tex.; $100,000; A. W. Chamberlain, H. W. Tallant and W. C. Winthrop.

CONTRACT PRICES.

PAVING.—Elizabeth, N. J.—The following bids have been received for paving West Grand St.: John F. Dolan, curb, 7½ cts. per lin. ft.; trap block, $1.99 per sq. yd.; telford, $1.65 per sq. yd.; B. & J. F. Shanley, curb, 4 cts.; trap-block, $1.19; telford, $1.05; Patrick Faulkner, curb, 5 cts.; trap block, $1.28; telford, $1.12.

Newark, O.—The lowest bids for paving East Main St. are as follows: Boren & Co., Porter brick, $1.07 and $1.13; Brennan & Nutter, Jones brick, 93 cts. per sq. yd.; with other brick, from $1.02½ to $1.53½. Bids for sandstone and Berea stone curbing ranged from 31 to 33 cts. per lin. ft. J. C. Wilson made the lowest bid.

Dayton, O.—There were 117 bids opened Feb. 5 for the paving on seven streets. They ranged as follows: Brick, $1.07 to $1.66 per sq. yd., according to the grade used; granite, $2.74 to $4; Medina stone, first-class, $2.33 to $3.25, and second class, $2 to $2.20; asphalt, $2.45 to $2.70; asphalt blocks, $2.40 to $2.80; Hallwood blocks, $1.50 to $1.75; Hayden blocks, $1.66 to $1.95; Parto blocks, $1.65.

LEVEE.—Columbus, O.—The contract for riprapping the levee has been awarded to Jacob Burn at $1.24 per perch, and for filling to E. M. Stanley at 13 cts. per cu. yd.

BROKEN STONE.—Boston, Mass.—The bids for the delivery of broken stone at Fort Warren have been opened by Lieut. Col. S. M. Mansfield. There were 14 bidders with bids ranging from $1.22 to $3.30 per ton. The Pigeon Hill Granite Co. made the lowest bid.

WRECKS.—Newport, R. I.—The following bids were opened by Captain Bixby, U. S. Engineer Office, Feb. 8, for removing wrecks of two schooners: Charles W. Johnston, Lewes, Del., $3,200 and $3,400; Enoch Townsend, Somer's Point, N. J., $4,365 and $4,345; William E. Chapman, New York, N. Y., $7,194 and $8,154; Davis Coast Wrecking Co., New Bedford, Mass., $9,995 for the first.

PIPE AND SPECIALS.—Boston, Mass.—The Water Commissioners have received bids for cast iron pipe and special castings, as follows: 20 tons 4-in. pipe, 600 tons 6-in., 60 tons of 8-in., 100 tons 10-in., 1,500 tons 12 in., 300 tons 16-in., and 150 tons castings. R. D. Wood & Co., Philadelphia, $26.88½ per ton; McNeal Pipe & Foundry Co., Burlington, N. J., $25.75 for pipe, $53.50 for castings: Radford Pipe & Foundry Co., Cincinnati, O., $25.40 and $50.40. Mellert Foundry & Machine Co., Reading, Pa., $28.90 for 4-in.; $27.78 for other sizes; $51.52 for castings; Warren Foundry & Machine Co., New York, N. Y., $26.90 and $52.50. The two lowest totals are R. D. Wood & Co., $82,536, and Radford Pipe Co., $81,722.

Mechanicsville, N. Y.—The contract for pipes for the new water-works has been awarded to R. D. Wood & Co., of Philadelphia, at $25.45 per gross ton delivered, and special castings, 2.23 cts. per lb.

Troy, N. Y.—The Water Commissioners have awarded the contract for iron pipe to R. D. Wood & Co., of Philadelphia, at the prices published last week.

RESERVOIR.—Atlanta, Ga.—Mr. R. M. Clayton, City Engineer, writes us that the contract for the construction of a reservoir of 200,000,000 gallons capacity for the water-works has been awarded to S. B. Mosby & Co., Bedford City, Va., at the following prices: puddle, 47.5 cts. per cu. yd.; embankment, 15.99 cts.; waste, 12.90 cts.; solid rock, 60 cts.; loose rock, 35 cts.; concrete, $5; brick, $14.50 per 1,000; clearing and grubbing, $25 per acre; total on approximate quantities, $52,347. There were 18 bids, the above being the lowest, while the highest was $97,002. A contract has also been let for 1¼ miles of railway work for a spur track to the pumping station. This was awarded to Briere & Russell, Savannah, Ga., at the following prices: solid rock excavation, 65 cts. per cu. yd.; loose rock, 30 cts.; earth, 12 cts.; culvert masonry, $3.50; paving, $1.25; 12 and 18 in. pipe, 45 and 60 cts. per lin. ft.; total, $5,811. There were 17 bids on this work, the highest being $9,720.

SEWER.—Brooklyn, N. Y.—The lowest bid for a cement pipe sewer in District No. 24 was from Edward Gorman: 30-in., $2.95 per lin. ft.; 18-in., $1.50; 15-in. $1.30; 12-in., 90 cts.; street basins, $93 each; manholes, $34 each.

MISCELLANEOUS.

JAIL.—Columbus, Ga.—The County Commissioners will receive bids until April 5 for the construction of a jail for Muscogee County.

ORDNANCE SUPPLIES.—Springfield, Mass.—Bids will be received by Col. A. R. Buffington, National Armory, until March 2, for the following supplies: Wheelock's improved compound engines, materials for boilers, hangers and shafting; Morse, Williams & Co.'s elevators, heating and lighting fixtures, grading, paving, flagging.

LIGHT FIXTURES.—Washington, D. C.—Bids will be received at the Treasury Department until Feb. 19 for furnishing and placing combination gas and electric light fixtures in the public buildings at Greenville, S. C., Kalamazoo, Mich., Monroe, La., Opelousas, La., Portsmouth, O., Sedalia, Mo., Texarkana, Ark., and Watertown, N. Y.

DREDGING.—Baltimore, Md.—The city has voted $30,000 for dredging the spring Garden and Bush St. dock.

STREET CLEANING.—Peoria, Ill.—The City Clerk has been authorized to ask bids for sweeping and cleaning the paved streets of the city.

St. Louis, Mo.—The Board of Public Improvements asks bids until Feb. 17, for cleaning by machine and manual labor the improved streets of the city, two contracts.

GAS.—New Orleans, La.—According to the compromise entered into with the Jefferson City Gaslight Co., the city agrees to pay annually, until March 1899, $30,000 for supplying and lighting the 858 street gas lamps now erected and $35 per lamp per year for any additional lights.

SUPPLIES.—Philadelphia, Pa.—Bids are asked until Feb. 16 for supplying the gas bureau with cast iron pipe, station meter, clay retorts, firebrick, paving and building brick, chain, electric zincs and coppers, etc. Address James H. Windrim, Directorof Public Works.

CURBING.—Holyoke, Mass.—Bids are asked until Feb. 16, 5 o'clock p. m., for 10,000 lin. ft. of granite curbing. M. J. Laporte, Chairman Committee on Sidewalks, Brookline, Mass. The Park Commissioners ask bids until Feb. 18 for 11,000 lin. ft. of curb stone.

BONDS.—Minneapolis, Minn.—The Park Commissioners will sell, March 5, park bonds to the amount of $30,000.

LEAD.—Portland, Ore.—Proposals for 50,000 lbs. of lead for caulking water pipes will be received until Feb. 29 by Frank T. Dodge, Clerk of the Water Committee.

PUMPING ENGINE.—Dallas Tex.—The City Council has received the following bids for pumping machinery: Holly Mfg. Co., a Gaskell high pressure engine, 6,000,000 gallons capacity, $28,000; 10,000,000 gallons, $50,000; low pressure, 10,000,000 gallons, $27,000; foundations, $3,875 extra; Henry R. Worthington, low service pump of 10,-

000,000 gallons and high service pump of 6,000,000 gallons capacity, $60,500; American Well Works Co., Aurora, Ill., low duty pump of 10,000,000 gallons capacity, $26,400; Texas Water-Works Const. Co., low service pump of 6,000,000 gallons capacity, $36,000; low service pump of 10,000,000 gallons capacity, $27,300.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Baldwin Locomotive Works, Philadelphia, Pa., have an order for 25 freight engines for the Lehigh Valley, to be used on the new Buffalo line. The Rogers Locomotive & Machine Works, Paterson, N. J., are building 6 express passenger engines for the Housatonic. The Roanoke Machine Works, Roanoke, Va., have an order for 4 freight engines for the Norfolk & Western. The Schenectady Locomotive Works, Schenectady, N. Y., have orders for 2 compound ten-wheel passenger engines for the Adirondack & St. Lawrence and 8 freight engines for the Duluth & Iron Range. The Rhode Island Locomotive Works, Providence, R. I., have an order for 40 engines for the Union Pacific. The Pennsylvania Co. will build 6 ten-wheel passenger engines at the Fort Wayne shops; cylinders 19 by 24 ins.; boilers 62 ins. diam., driving wheels 68 ins. diam., weight 120,000 lbs. An express passenger engine is being designed by Mr. T. N. Ely, of the Pennsylvania R. R. A noiseless steam dummy engine, weighing 20 tons, is wanted by the Wilmington Street Ry. Co., 29 Broadway, New York.

CARS.—The Roanoke Machine Works, Roanoke, Va., have an order for 2 passenger cars and 200 freight cars for the Norfolk & Western. The Jackson & Sharp Co., Wilmington, Del., has an order for 50 passenger cars for the Chicago & South Side elevated railway (Eng. News, Jan. 16). The Barney & Smith Mfg. Co., Dayton, O., has an order for 12 passenger cars and 2 dining cars for the Cleveland, Cincinnati, Chicago & St. Louis. The Ohio Falls Car Co., of Jeffersonville, Ind., has an order for 300 box cars. The Louisville, New Albany & Chicago has placed orders for 1,000 freight cars. The Lehigh Valley has ordered 25 passenger cars, 2,000 box cars and 2,000 gondola cars, required by the opening of the new Buffalo line. The Baltimore & Ohio will add 2,000 box cars to its equipment. The Southern Pacific will build 750 freight cars at its Sacramento shops.

TRAIN SHED.—The Philadelphia & Reading will build a large iron train shed at Wayne Junction, Pa.

BUSH TRACK BOLTS.—The Pennsylvania has ordered from Ralston & Henry, of Philadelphia, Pa., 1,200 Bush interlocking bolts for a bridge on the West Pennsylvania Division.

HAUGH, KETCHAM & CO., of Indianapolis, Ind., had their structural iron works nearly destroyed by fire Feb. 7. The company had contracts on hand for the U. S. Government building at the World's Columbian Exposition.

BYRAM & CO., exclusive manufacturers of the Colitau cupola furnace, report orders from Greenville, Tex., Waltham, Mass., and Wallace, Idaho.

THE RYAN-McDONALD MFG. CO., of Baltimore, Md., has appointed James & Co., of Chattanooga, Tenn., selling agents for Chattanooga and vicinity for its mine, dump and small cars, light locomotives, vertical engines and boilers, derrick winder and fittings, etc.

THE BERLIN IRON BRIDGE CO., of East Berlin Conn., has a contract for a new building for the Chester Pipe & Tube Co., of South Chester, Pa. It will be 170 by 52 ft., and constructed entirely of iron.

COMPANIES.—Eno Rail Joint Co., Newark, N. J., $60,000; J. A. Eno, Henry Conger and E. O. Keasley, National Paving Co., Baltimore, Md., $100,000; John Roche, L. W. Hopkins and Amos L. Merriam, Thayer Water Gas Furnace Co., of Pittsburg, Pa., $5,000; W. C. Thayer, John Oakley, E. B. Scull, Railway Automatic Time & Danger Signal Co., Des Moines, Ia., $100,000; E. R. Hotchins, R. E. Fitzgerald and J. R. Grinor, Lawson Non-Explosive Boiler Co., O., $300,000; D. T. Lawson, Wm. Felton and Chas. S. Lord.

CURRENT PRICE LIST.

RAILS.—New York: $30; old rails, $20 to $20.50 for iron and $14 to $15 for steel; girder rails, $40. Pittsburg: $30; old rails, $22 to $23 for iron and $16.75 to $17.50 for steel. Chicago: $31.50 to $32; old rails, $21.75 to $22 for iron and $15 for steel.

TRACK MATERIALS.—New York: steel angle bars, 1.65 to 1.75 cts.; spikes, 1.95 to 2.1 cts.; track bolts, 2.6 to 2.75 cts., with square and hexagonal nuts. Pittsburg: splice bars, 1.7 to 1.8 cts. for iron or steel; iron or steel spikes, 2.15 to 2.2 cts.; iron track bolts, 2.65 cts. with square and 2.75 cts. with hexagon nuts. Chicago: splice bars, 1.85 cts. for iron and steel; spikes, 2.15 to 2.25 cts.; track bolts, 2.65 to 2.7 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 57½ and 47½% on black and galvanized butt-welded; 67½ and 55% on black and galvanized lap-welded. Casing, 55%.

FOUNDRY PIG IRON.—New York: $14 to $17.50. Pittsburg: $14 to $15.75. Chicago; $14 to $16.

LEAD.—New York: 4.05 to 4.1 cts. Chicago: 3.95 cts. St. Louis: 3.85 cts.

STRUCTURAL MATERIAL.—New York: beams, 2.4 to 2.8 cts.; channels, 2.4 to 2.5 cts.; angles, 1.9 to 2.1 cts.; tees, 2.4 to 2.75 cts.; sheared iron plates, 1.85 to 2.25 cts.; steel plates, 1.9 to 2.1 cts. for tank, 2.15 to 2.3 cts. for shell, 2.4 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 2.5 cts.; channels, 2.5 cts.; angles, 1.9 to 2 cts.; tees, 2.25 to 2.35 cts.; universal iron mill plates, 1.9 to 2 cts.; sheared steel bridge plates, 1.9 to 2 cts.; refined bars, 1.75 to 1.8 cts.; steel plates, 2 to 2.05 cts. for tank, 2.1 to 2.15 cts. for shell, 2.35 to 2.4 cts. for flange, 3.75 to 4.25 cts. for firebox. Chicago: beams, 2.6 to 2.75 cts.; channels, 2.67 to 2.75 cts.; angles, 1.95 to 2.1 cts.; tees, 2.25 to 2.5 cts.; universal plates, 2.12½ cts.; sheared steel plates, 2.2 to 2.25 cts.; steel plates, 2 cts. for tank, 2.75 to 2.9 cts. for shell, 3 to 3.25 cts. for flange.

DREDGING IN PORT JEFFERSON Inlet, N. Y. Engineer Office, U. S. Army, Room H 7, Army Building, 39 Whitehall St., New York, N. Y., Jan. 25, 1892. Sealed proposals in triplicate for dredging in Port Jefferson Inlet, N. Y., will be received at this office until twelve (12) o'clock noon on Thursday Feb 25, 1892. The attention of bidders is invited to the Acts of Congress approved Feb 26, 1885, and Feb. 23, 1887, Vol. 23, page 332 and Vol. 24, page 414, Statutes at Large. Further information can be obtained at this office. Applications should be indorsed on the envelopes, "Official Business." D. C. HOUSTON Colonel of Engineers. 5-4t

Notice to Bridge Builders.

Sealed proposals will be received at the office of the Board of Public Works of the City of Duluth, Minn., until 2 o'clock P. M. of Monday, Feb. 29, 1892, for the construction of an iron and steel viaduct on Lake Ave. of this city. Length, 684 ft.; width, 60 ft., general drawings, specifications, etc., of which may be seen at this office. No bid will be received unless accompanied by a certified check for a sum not less than 10 per cent. of the amount of the proposal, or a satisfactory bond of at least 25 per cent. of the amount of said proposal.

Bidders are requested to state what will be the maximum clear headroom beneath the 77-ft. span in case they submit an arrangement other than shown on general drawings, the aim being to acquire 20 ft. clear headroom if possible without changing the grade of the viaduct as shown.

Bids received after 2 o'clock P. M. of above day will be rejected. The Board reserves the right to reject any or all bids. Address communications to

T. W. ABELL,
Clerk Board of Public Works,
Duluth, Minn.

Dated Jan. 26, 1892. 6-4t

Mechanicville N. Y., Water-Works.

NOTICE TO VALVE AND HYDRANT MANUFACTURERS.

SEALED PROPOSALS will be received for the manufacture and delivery of about 75 valves and boxes and 42 fire hydrants by the undersigned, Water Commissioners of the Village of Mechanicville, N. Y., at their office up to 3 p. m. of Friday, Feb. 19, 1892, at which time they will be publicly opened.

Each proposal must be made upon the "form" furnished by the Commissioners.

The right to reject any or all bids is reserved by the Commissioners, as is also the right to purchase the valves and hydrants separately.

Quantities, specifications and other information can be obtained from the Commissioners or the Engineer.

Address all communications to WM. B. NEILSON, Clerk of the Board of Water Commissioners.

JOHN C. GREENE, Pres.
WM. B. NEILSON, Clerk.

AMOS BRYAN,
THOMAS H. SLAVIN,
JOHN SHEEHAN,
DANIEL RYAN,
ALBERT PATRICK.
} Comrs.

MECHANICVILLE, N. Y., Jan. 19, 1892.
P. H. BAERMANN, Eng.,
6-2t No. 10 First St., Troy, N. Y.

Postponed Opening of Bids.

NOTICE TO JAIL CONTRACTORS.

Notice is hereby given that sealed bids will be received by the undersigned until 12 o'clock M. on first Tuesday in April, 1892 (April 5), at Ordinary's office of Muscogee County, Georgia, for the erection and completion of a county jail for Muscogee County, Georgia. Plan and building specification can be seen at office of the Ordinary. Each bidder will be required to furnish sample of such grating and material as he proposes to bid on, said samples not to be less than 18 × 24 ins., Board retaining samples of successful bidder until completion of the work, and to furnish specification of steel and iron work, and construction of same to conform to size of cells, etc., as shown on said plan. Successful bidder will be required to give bond as the law directs, the Board reserving the right to reject any and all bids.

LOUIS F. GARRARD,
JOHN H. BASS,
WILLIAM L. TILLMAN,
County Commissioners.

7-3t

PROPOSALS FOR SWEEPING AND Cleaning Streets in the District of Columbia.—Office of the Commissioners of the District of Columbia, Washington, Jan. 23, 1892.—Sealed proposals will be received at this office until 12 o'clock m., of Tuesday, Feb. 23, 1892, for sprinkling, sweeping, and cleaning improved streets and avenues in the District of Columbia for five years from June 30, 1892, subject to annual appropriations by Congress. Blank forms of proposals and specifications can be obtained upon application therefor at this office, together with all necessary information, and bids upon these forms will alone be considered. The right is reserved to reject any and all bids or parts of bids. J. W. DOUGLASS, J. W. ROSS, W. T. ROSSELL, Commissioners, D. C. 5-6t

Mechanicville, N. Y., Water-Works.

NOTICE TO CONTRACTORS.

SEALED PROPOSALS will be received for the entire construction of these works by the undersigned, Water Commissioners of the Village of Mechanicville, N. Y., at their office, up to 3 P. M. of Wednesday, Feb. 24, 1892, at which time they will be publicly opened.

Each proposal must be made upon the "form" furnished by the Commissioners.

The right to reject any or all bids is reserved by the Commissioners.

Each proposal must be accompanied by cash draft or certified check for five hundred dollars ($500) payable to the Treasurer of the Mechanicville Water Board, as liquidated damages for failure to execute the contract with security, approved by the Commissioners within the time named.

Quantities, specifications and other information can be obtained from the Commissioners or the Engineer.

Plans, profiles and other drawings will be on exhibition at the Commissioners' office, on and after Feb. 8, 1892.

Address all communications to WM. B. NEILSON, Clerk of the Board of Water Commissioners.

JOHN C. GREENE, Pres.
WM. B. NEILSON, Clerk.

AMOS BRYAN,
THOMAS H. SLAVIN,
JOHN SHEEHAN,
DANIEL RYAN,
ALBERT PATRICK,
} Comrs.

MECHANICVILLE, N. Y., Jan. 19, 1892.
P. H. BAERMANN, Eng.,
6-3t No. 10 First St., Troy, N. Y.

Bids Solicited for Street Railway Franchise,

AT PLAINFIELD, N. J.

The Subscriber, the City Clerk of Plainfield, N. J., solicits bids pursuant to resolution of the Common Council of said City, as follows:

"Whereas, it is in the sense of the Common Council that the best interests of the City of Plainfield require that a street railway in this city should be constructed, and put into actual operation at the earliest date practicable,

"Resolved, that the City Clerk be and he hereby is instructed to advertise in the Engineering News and Street Railway Journal, for sealed proposals to be submitted to him on or before Monday, March 7, 1892, to be opened at the regular meeting of the Common Council to be held on that date at the Council Chamber in said city at eight o'clock, P. M., which proposals shall set forth that the proponents offer to organize under the Act of the Legislature of the State of New Jersey entitled, 'An Act to Provide for the Incorporation of Street Railway Companies and to Regulate the Same,' approved April 6, 1886, and the acts amendatory thereof, and supplemental thereto, and shall specify in detail the route or routes proposed, the character and description of motive power, rails, street cars and other equipment, and the terms and advantages offered."

FRANK W. RUNYON, City Clerk.
Dated Plainfield, N. J., Feb. 3, 1892. 6-2t

Grading and Macadamizing.

Proposals will be received by the Board of Supervisors of Queens County, at the County Court House, Long Island City, until the 23d day of February, 1892, at 12 o'clock M., for grading, regulating, macadamizing and otherwise improving a highway three miles in length connecting the villages of Flushing and Jamaica in said county. Plans may be seen at and specifications obtained from the office of the Engineer, G. A. Roullier, No. 20 Main St., Flushing, N. Y. Bonds in the sum of $10,000 will be required. All proposals must be made out on the blank forms provided for the purpose and must be accompanied by a certified check in the sum of $2,000.

The right is reserved to reject any or all proposals.

By order of the Board of Supervisors of Queens County.

6-2t ROBERT SEABURY, Clerk.